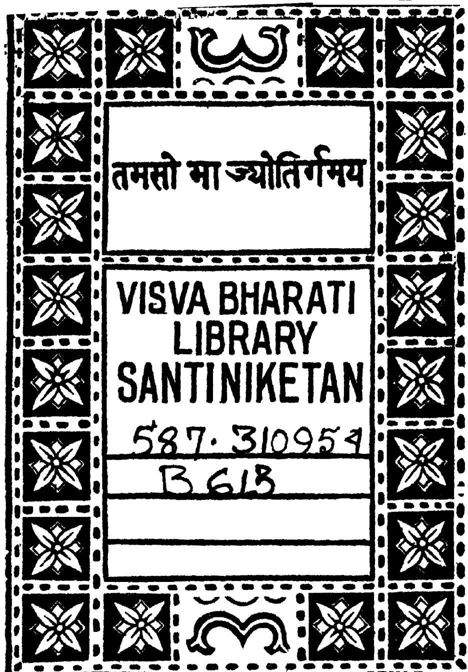




Lygodium flexuosum Bedd

Frontispiece

THE FERNS OF BOMBAY

BY

E. BLATTER, S.J., PH.D., F.L.S.
Professor of Botany, St. Xavier's College, Bombay

AND

J. F. d'ALMEIDA, B.A., B.Sc. (Hon.)
Professor of Botany, St. Xavier's College, Bombay

With 2 coloured and 15 black and white plates, and 43 text figures.

BOMBAY
D. B. TARAPOREVALA SONS & CO.
190 HORNBY ROAD, FORT
1922

PRINTED AT THE
DIOCESAN PRESS, MADRAS
1922

PREFACE

It is strange that the ferns, though distinguished by an infinite variety in the form and division of their leaves and the elegant beauty of their whole appearance, received so little attention in the Bombay Presidency on the part of botanists as well as of amateurs. An explanation of the fact may be found in the circumstance that just near the centres of human commerce in the Presidency, the fern vegetation is very scanty or almost *nil*. Other parts with a rich growth of ferns are inaccessible to most of us during the four rainy months of the year, when plant-life is at its best. A second reason might be the difficulty that is generally experienced in the identification of the members of this class of plants. To obviate the latter difficulty we offer this volume to the public.

We have to thank Professor J. P. Mullan for taking a number of photographs, Miss Mercia Stanton, Mr. Jos. Fonseca and Mr. Sutaria for the drawings and Miss Eileen Rosario for the coloured plates.

E. Blatter,
J. F. d'Almeida.

St. Xavier's College,
February 2, 1922.

CONTENTS

LIST OF PLATES

Frontispiece *Lygodium flexuosum* Bedd. (coloured).

INTRODUCTION

1. History of our knowledge of the Fern Flora of the Bombay Presidency

Of those that wrote expressly on the Flora of the Presidency, Graham[1] is the first to give some information on the cryptogamic vegetation. He mentions twenty-five species of ferns with notes as to the places where they had been collected. Dalzell and Gibson[2] did not add anything to the knowledge of the cryptogams. We read in the preface to their 'Bombay Flora': 'The cryptogamic portion of the catalogue has, in order to meet the present wants of our readers, been literally transcribed from that of Mr. Graham, but we hope, on a future opportunity, to be able to present it to the public in a more compact and enlarged form.' Whether their hope was ever realized we are not able to say; at least we could not find any further publication on the subject by

[1] J. Graham: Catalogue of the Plants growing in Bombay and its vicinity, 1839.

[2] A. Dalzell and A. Gibson: The Bombay Flora Bombay, 1861.

either of the two botanists. In 1886 H. M. Birdwood[1] wrote a catalogue of the Flora of Matheran, in which he enumerates twelve species of ferns as growing in that place. In 1887[2] he published a catalogue of the Flora of Mahableshwar and Matheran mentioning fourteen species as occurring in both places. In a final revision of the same catalogue in 1897 the species of ferns found at Mahableshwar and Matheran[3] amount to thirty-two. The latest and at the same time the richest contribution towards the knowledge of the fern-vegetation of the Bombay Presidency is contained in Vol. V of the Journal of the Bombay Natural History Society, where T. R. M. Macpherson[4] gives a list of seventy-five species gathered in North Kanara. Reference is sometimes made to the Bombay-ferns in W. Hooker's 'Species Filicum' and 'Synopsis Filicum,' in Smith's 'Historia Filicum,' R. H. Beddome's 'Ferns of Southern India,' 'The Ferns of British India,' and especially in his

[1] H M. Birdwood A Catalogue of the Flora of Matheran, in Journal, *B.N.H.S.*, vol i, p 203

[2] H M. Birdwood: A Catalogue of the Flora of Mahableshwar and Matheran, in Journal, *B N H S*, vol. ii, p 107

[3] *Ibid.*, vol, x, p 394.

[4] T.R.M Macpherson, List of Ferns gathered in North Kanara; in Journal, *B.N H.S*, vol v, p. 375

PLATE I



A. FERN WITH A CREEPING STEM.

Rh. = Rhizome.
P. = Pinna.
C. = Young frond, circinate in bud.

B. FERN WITH AN ERECT STEM.

Cd. = Caudex.
St. = Stipe.
R. = Rachis.
C. = Young frond, circinate in bud.

To face page 3

'Handbook to the Ferns of British India, Ceylon and the Malay Peninsula.' Here we must not forget to mention Gray who, in his treatise on the 'Botany of the Bombay Presidency,'[1] mentions about fifty species of Ferns.

If our readers wish to consult the plant-material on which this volume is based, they will find a complete collection of the ferns mentioned, in the Herbarium of St. Xavier's College. In addition we examined the herbaria of the Economic Botanist at Poona, of the Bombay Natural History Society, of Mr. L. J. Sedgwick, and of the Sibpur Botanic Gardens, Calcutta.

2. The Structure of Ferns

Before the beginner can proceed with the study of Ferns, it will be well for him to be acquainted with their structure and the terms which are in vogue and which it is impossible to omit in any treatise on Ferns, however elementary it may be. If the terminology is made clear at the outset, very little difficulty will be experienced by the reader in the course of his studies of Ferns.

[1] W.: Gray: The 'Botany of the Bombay Presidency'; in *Bombay Gazetteer*, vol. xxv.

The Root. Ferns possess roots by which they are fastened to the soil and obtain nutriment therefrom. These roots consist entirely of fibres and are said to be *fibrous* ; they have a more or less rigid wiry texture and, when young, are covered with fine soft downy hairs, termed *root-hairs.* The roots are borne on the underside of the stem, when the latter is prostrate or creeping along the ground ; but when the stem is more or less erect, they arise towards its lower end on all sides indifferently and proceed from amongst the bases of the decayed leaves.

The Stem. The stem forms either an upright or creeping stock. The upright stem is called *caudex.* [Plate I.-B. Cd.] Though the caudex rises not much above ground in most species, there are some ferns in which it reaches a height of thirty to fifty feet or more and gives a tree-like appearance to the plants. The latter are consequently known as *Tree-Ferns* or *Arborescent Ferns.* The creeping or prostrate stem is known as the *rhizome.* [Plate I.-A. Rh.] Parts of the stem not buried in the soil are often covered with hairs or scales and sometimes so thickly as to become quite shaggy.

The Frond. The leaves of ferns consist of two parts—(1) the leafy portion which is termed the *frond* and (2) the stalk which is called the *stipe.* [Plate I.-B. St.] When the stipe is wanting the frond is said to be *sessile.* The fronds of ferns are either *barren* or *fertile.* As a rule the latter differ scarcely from the former. Sometimes they vary greatly, the barren ones presenting the ordinary leafy appearance, the fertile being contracted often to such an extent that the leafy part is entirely absent.

The young fronds of ferns (except the *Ophioglossaceæ*) present a very characteristic appearance, the upper portion being coiled inwards like a watch spring, and as growth proceeds the coils unwind. Hence the fronds of ferns are said to be *circinate* (Lat. *Circino*, I turn round) in bud.

Fronds vary much in size, some kinds being less than one inch, whilst others fifteen to twenty feet long.

Fronds are either *simple* or *compound.* The simple frond is one which consists of one piece even though it is cut into lobes or segments.

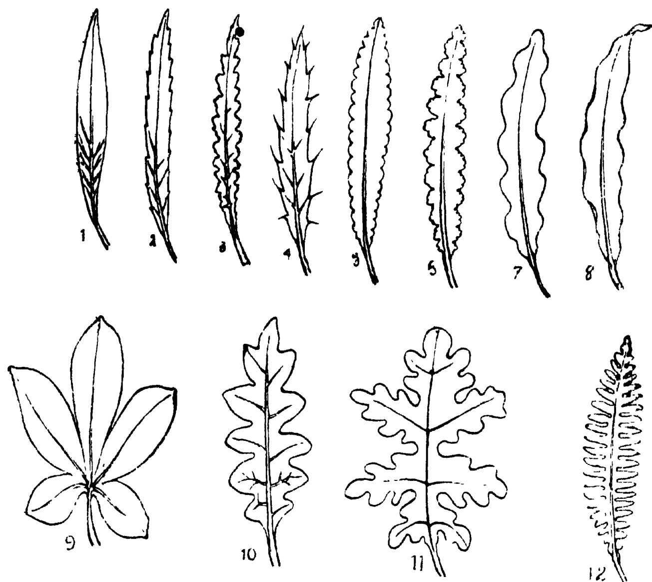
The compound frond is one which consists of two or more pieces, each of which may be

similarly divided. In compound fronds, the primary divisions are termed *pinnæ* [Plate I.-A. and B. p.] and when more than once divided the ultimate ones are known as *pinnules*. Compound fronds may be of, the *palmate* or *pinnate* type. In the former the leaflets all radiate from the apex of the stipe. Such fronds are said to be *one-foliate*, *two-foliate* or *binate*, *three-foliate* or *ternate*, etc. according to the number of leaflets they possess. In the pinnate type the divisions or pinnæ are arranged on either side of the prolongation of the stipe termed *rachis*. [Plate I.-B. r.] When the pinnæ are themselves pinnate and bear pinnæ of the second order, the frond is termed *bipinnate*; when these secondary pinnæ are again pinnate, the frond is *tripinnate*. If the division extends beyond this, the frond is *decompound*.

The Margin. The following terms are employed to describe the edges of fronds or of the parts of fronds [Plate II.] :—

(1) *Entire*, if the margin is even. (2) *Serrate*, if it has sharp teeth and all point to the apex like the teeth of a saw. (3) *Biserrate*, if the teeth themselves are serrate. (4) *Serrulate*, if the teeth are minute. (5) *Spinulose-serrate*, if the teeth are spiny. (6) *Crenate*, if the teeth are

PLATE II



DIFFERENT VARIETIES OF MARGIN.

1. Entire. 2. Serrate. 3. Biserrate. 4. Spinulose serrate.
5. Crenate. 6. Bicrenate. 7. Sinuate. 8. Wavy or undulate.
9. Palmatifid. 10. Pinnatifid. 11. Bipinnatifid. 12. Pectinate.

To face page 6

rounded. (7) *Crenulate*, if the teeth are minutely crenate. (8) *Bicrenate*, if the crenatures themselves are crenate. (9) *Sinuate*, *sinuous*, *sinuose*, if the margin has deep concavities and convexities. (10) *Wavy* or *undulate*, if the margin is wavy. (11) *Crisped* or *curled*, if the margin is very irregular, being twisted and curled.

When the margin of the frond or of a part of it is more deeply divided than is the case in the above instances, the suffix 'fid' is employed to describe it, and the divisions are termed *lobes* or *segments*. Hence, according as the frond or part of the frond belongs to the palmate or pinnate type, it is said to be *palmatifid* or *pinnatifid*. If the divisions of a pinnatifid frond or part of frond are again incised the terms *bi-pinnatifid* or *two-pinnatifid*, *tri-pinnatifid* or *three-pinnatifid*, etc. are used. If a frond or part of it is deeply incised and the divisions are narrow and close so as to resemble a comb, the same is said to be *pectinate*.

The Apex. The apex of the frond, whether simple or compound, or of the pinnæ or pinnules, or of the segments, varies considerably in outline and has received various names. [Plate III.-B.] It is *obtuse* or *blunt*, if it is rounded; *retuse*, if it is rounded with a rounded depression in the

middle; *emarginate*, if the depression is sharp; *acute* or *sharp-pointed*, if it is sharp so that the two margins form an acute-angle; *acuminate* or *taper-pointed*, if the point is very long and tapering; *mucronate*, if it is rounded and bears at the top a pointed process; *truncate*, if it seems to be cut across.

Shape. The following are the common terms used in descriptions to express the general outlines of fronds or the parts of fronds. [Plate III.-C. and Plate IV.] They are said to be *acicular* when they are needle-shaped; *linear*, if they are narrow with the two margins parallel; *subulate* or *awl-shaped*, if equally narrow but tapering to a very fine point; *lanceolate* or *lance-shaped*, if elongated and gradually tapering towards the base and apex; *oval* or *elliptical*, if like the last but relatively shorter and broader; *oblong*, if of much the same breadth but rounded at the base and apex; *ovate* or *egg-shaped*, if broadest and rounded off towards the base and pointed towards the apex; *obovate*, if just the reverse of ovate; *cordate*, if pointed at the apex and broad and notched at the base (this term is often applied to a frond or part of a frond if simply the base is notched); *obcordate*, if just the reverse of cordate; *reni-*

form or *kidney-shaped*, if rounded at the apex, broader than long and notched at the base; *obreniform*, if the reverse of reniform; *cuneate* or *wedge-shaped*, if broad at the apex and tapering towards the base; *sagittate* or *arrow-shaped*, if shaped like an arrow-head with the two basal lobes directed backwards; *hastate* or *halberd-shaped* if the two basal lobes are directed outwards; *oblique* or *unequal*, if the two halves of the frond are not equal; *falcate* or *sickle-shaped*, if curved like a sickle; *auricled*, if they bear more or less rounded or ear-shaped lobes; the lobes are then termed *auricles*.

It will be noted that in actual descriptions the terms above explained are often coupled together as linear-lanceolate, elliptic-ovate, and so on, to suggest that the shape is something between the two.

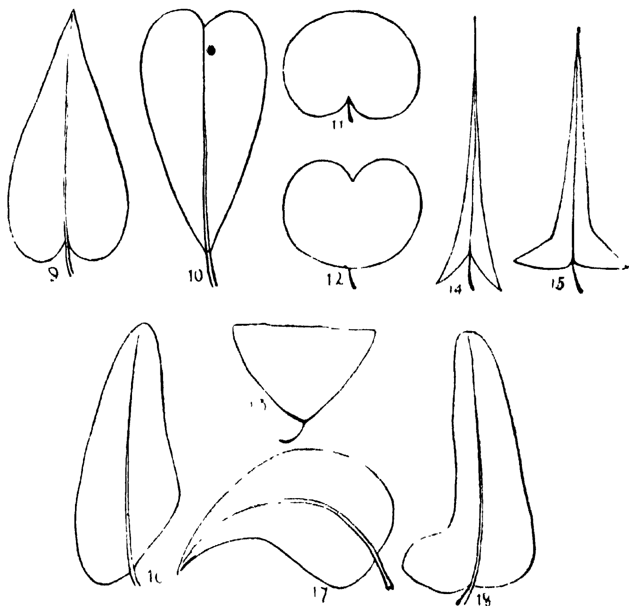
Texture. The texture of fronds varies very much in the different species. It is said to be (*a*) *membranous* or *membranaceous*, if it is thin like a membrane; (*b*) *herbaceous*, if it has the texture of a herb; (*c*) *coriaceous*, if it is leathery; (*d*) *fleshy* or *carnose*, if it is succulent.

Surface. The surface of fronds may be quite smooth or covered, with hairs, glands or scales, or they are covered, particularly the

under-surface, with white or yellow meal. The rachises and stipes may also be covered with hairs and scales.

Venation. The venation or the mode of arrangement of the veins in the fronds often form an important criterion for distinguishing ferns. [Plate V.] The midrib of a simple frond or of the pinnæ or pinnules of a compound frond is called the *costa.* The first branches of the midrib are called *veins* and the branches proceeding from the veins, *veinlets.* Veins or veinlets are spoken of as *free* when they are unconnected with the neighbouring ones ; *anastomosing* when the veinlets of one vein are connected with those of the next ; *reticulate* when they anastomose so as to form a net-work. Free veins are either *simple* or *branched.* Branched veins may be either (*a*) *forked* when they break up into two or more branches after leaving the costa ; (*b*) *pinnate* when they run from the costa to the margin giving off branches on both sides ; or (*c*) *radiate* when the veins spread out from a definite point at the base of the frond. *Areoles* or meshes are spaces formed by the anastomosing of veins. Veins or veinlets are said to be *excurrent* when directed towards the margin and *recurrent* when directed away

PLATE IV



Continued from Plate III : 9. Cordate, 10. Obcordate, 11. Reniform, 12. Obreniform, 13. Cuneate, 14. Sagittate, 15. Hastate, 16. Oblique, 17. Falcate, 18. Auricled.

To face page 10

from it. The apices of veins or veinlets are said to be *clavate* when thickened like a club.

Reproductive Organs.

1. *Receptacle.* The sporangia or spore cases are arranged on a projection of tissue termed the *receptacle* or *placenta.* Its position on the frond varies. It may terminate a vein or its branches; it may be on the point where the veins fork, or on the point of union of two or more veinlets, or on the back of a vein or veinlet. It presents various forms, being a rounded elevation, or more elongated or conical, or very long and filiform or ridge-like.

2. *Sporangium.* (Fig. 1). The *sporangia* or *spore-cases* or *capsules* are the organs which contain the reproductive spores (sp.). They are minute roundish oval bodies containing a single cavity and are usually stalked, but sometimes sessile. They are encircled by a complete jointed elastic ring termed an *annulus* (an.) or destitute of such

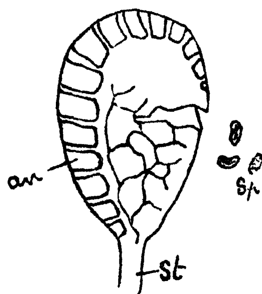
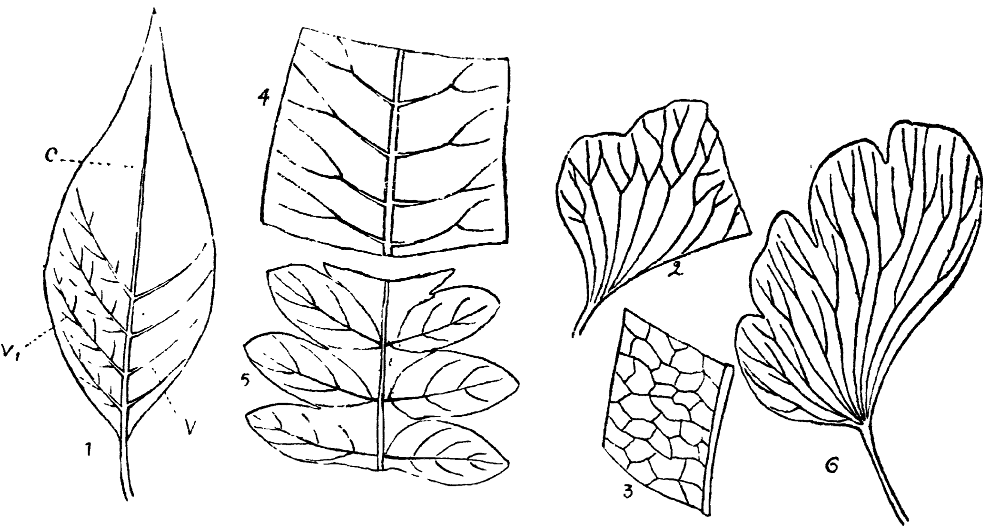


FIG. 1.—A sporangium (magnified); *An.* = Annulus; *St.* = Stalk; *Sp.* = Spores.

a ring. The ring when present is either (1) vertical if it passes vertically from the stalk over the apex of the sporangium, or (2) horizontal when it passes horizontally round the sporangium at about its middle, or (3) apical when it is at the apex, or (4) oblique when it passes obliquely round the sporangium. When the sporangium reaches maturity, the elasticity of the annulus gives way, the case opens in a direction transverse to the ring and the spores are dispersed in the shape of fine dust. Exannulate sporangia burst by means of a simple slit or pore. Groups of sporangia are termed *sori* when the individual sporangia are distinct, and *synangia* when they are coherent. The sporangia in the latter case are exannulate. Sori vary in shape and may be linear, round, oblong, oval, etc.

3. *Indusium.* Sori are either naked or provided with hairs and scales or covered in the first instance at least with a membranous or rather leathery covering called an *indusium* (a shirt) or *involucre* (L. *involucrum*, cover). The presence or absence of the indusium and its form when present are of importance in classification. The indusium is attached to the receptacle in various ways.

PLATE V



(1) It may be in the form of a disc and attached by its centre to the centre of the receptacle, the edge being free (*peltate*)

(2) As a rule it is more or less elongated and attached to the side of the receptacle (*lateral*), (*a*) either by a point or notch on one side, in this case it is *reniform*, *oval* or *oblong*; or (*b*) by the entire length of one side when it is *linear*. Sometimes the indusium is attached all round the base of the receptacle and it is at first globose and entire enveloping the sorus when young, eventually opening at the summit and then it resembles a cup (*caliciform*)

3. Life History of the Fern

The spores which are borne inside the sporangium are extremely minute bodies of a dark brown colour resembling the pollen grains of flowering plants in structure, and are like them cells consisting of the living substance, *protoplasm*, enclosed, as a rule, in a double coat made up of an outer *exine* and an inner *intine*. The former is provided with markings and elevations of various patterns. Provided with this double coat spores are capable of resisting

longer or shorter periods of unfavourable conditions.

In suitable soil the spore germinates, growing out into a filmy, heart-shaped plate scarcely one-third of an inch across. This is known as the *prothallus* or *prothallium* (Fig. 2). It very much resembles a liverwort, but can be distinguished from it by its paler green colour. It lies prostrate on the soil to which it is attached by a number of root-like processes, *rhizoids* (*Rh.*) which are given off from the under-surface. Amongst the rhizoids one can distinguish numerous small projections. These are the male sexual organs, the *autheridia* (Fig. 2 Anth. and Fig. 3). Each antheridium contains several male sexual cells—the *sperms* (sp.). Near the notch of the heart-shaped prothallus may be seen the female sexual organs—the *archegonia* (Fig. 2 Arch. and Fig. 4).

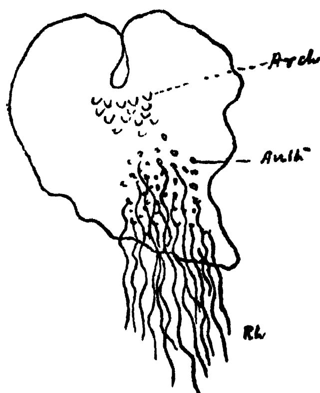


FIG. 2.—A prothallium (magnified); *Rh.* = Rhizoids; *Anth.* = Antheridium; *Arch.* = Archegonium.

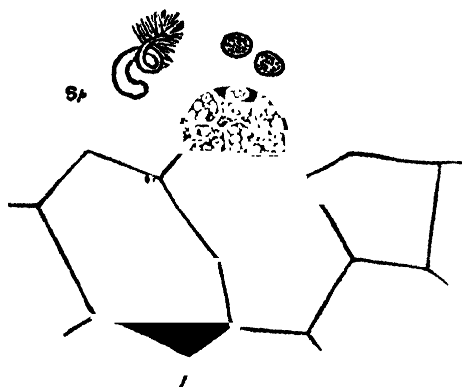


FIG. 3.—An Antheridium (magnified); *Sp.* = Sperm.

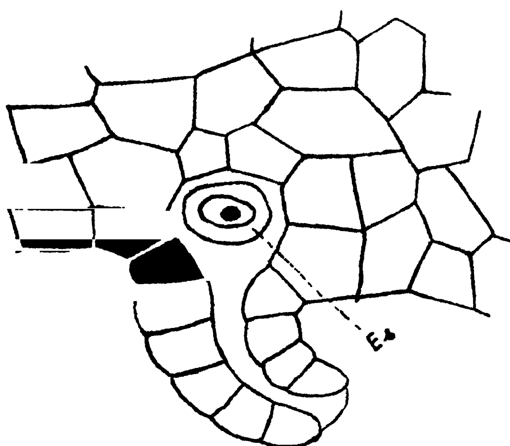


FIG. 4.—An Archegonium (magnified); *Es.* = Egg-cell.

Each archegonium is flask-shaped and contains in its lower swollen portion a single female sexual cell—the *ovum* or *egg-cell* (Es.).

The sperm is a long spirally coiled body, blunt behind and tapering to a point in front where it bears fine hair-like processes termed *cilia*, by the vibratile movements of which it moves about in the water which saturates the soil in which the prothalli are growing. Sooner or later it comes into the neighbourhood of an archegonium, being attracted to it by the mucilaginous exudations from the neck. It enters the archegonium by the neck and fuses with the egg-cell. Thus fertilization is accomplished.

From the fertilized egg-cell, what is commonly known as the 'Fern Plant' is produced. This is at first extremely small and grows at the expense of the food-material supplied by the prothallus to which it remains attached till it is able to spread its own roots and live independently. (Fig. 5.)

From what has been said above it will be evident that there are two stages or phases in the life-history of the Fern :—(1) The short-lived prothallus which grows from the spore and bears the sexual cells, and (2) the 'Fern

Plant' which is the result of the union of the sperm and egg-cell, and which, when it is adult, produces the asexual spores. The former is known as the sexual generation, the latter as

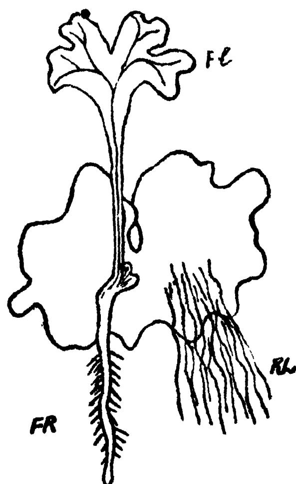
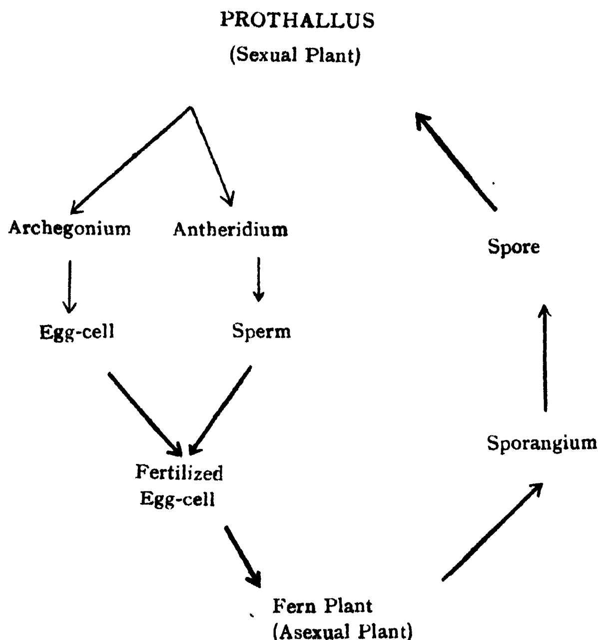


FIG. 5.—Young fern plant attached to Prothallus.
Fl. = First frond ; *FR.* = First root ; *Rh.* = Rhizoids of Prothallus.

the asexual. Neither of these generations can be produced independently of the other ; there must be an interposition of the one generation between two of the other. The life-cycle of the fern thus shows what is known as the

'alternation of generations'. This is represented in a graphic manner below :—



4. Vegetative Reproduction

Besides the sexual reproduction illustrated in the life-history described above, many ferns are capable of reproducing themselves vegetatively. Thus the fronds of *Adiantum cauda-*

tum L. and *Adiantum lunulatum* Burm. often root at the extremities producing new plants which separate from the parent plant and live independently. In the genus *Nephrolepis* the rhizome sends out several stolons which bear buds that develop into new plants. Small buds or bulbils which fall off and become independent individuals are often produced on the fronds of several ferns like *Ceratopteris thalictroides* Brong., *Asplenium viviparum* Presl., *Asplenium Belangeri* Kze., *Anisogonium esculentum* Presl., and *Aspidium cicutarium* Sw. In *Aspidium macrophyllum* Sw. the buds arise on the rhizome.

5. Distribution and Habitats of Ferns

To gain an idea of the distribution of Ferns in the Bombay Presidency, it will be necessary to briefly describe the physical features of the country which have a great influence on the vegetation. Along the sea coast to the north and south of Bombay is a tract of low-lying country, the Konkan, bounded on the east by the Western Ghats. The latter mountains form the western escarpment of the high plateau of the Deccan, a good portion of which comes

within the boundaries of the Presidency. North of the river Tapti are Gujerat (including Kathiawar), Kutch and the isolated province of Sind.

The rainfall of the whole area is not even. The monsoons which blow from the Arabian Sea spend most of their strength in the Konkan and on the Western Ghats, more so towards the south. Thus the Deccan is robbed of a large portion of its rain by the screen of the Ghats. Sind, Gujerat and Kutch receive very little rain. In consequence of this uneven distribution of rainfall, the vegetation of the country is not uniform. The last mentioned areas are semi-desert and it would be too much to expect ferns to grow here, though *Adiantum caudatum* L. var. *edgeworthii* Bedd. has been recorded by Lowe to occur in Sind. It is also possible that *Adiantum lunulatum* Burm. which is common throughout the rest of the Presidency, and the cosmopolitan *Adiantum capillus veneris* L. occur in Gujerat and Sind.

In the Konkan and on the Ghats, as far south as Mahableshwar, where the rainfall is considerable, though not so great as in the country to the south of this hill, are the deciduous forests, whose trees shed their foliage

during the dry season. The ferns that grow here are, for the most part, green only in the monsoons, drying up to the level of their rhizomes after the heavy rains are over. In this dormant state, they await the next wet season when they again send out fresh foliage. Others again roll up their fronds after the rains and so resist the dry season.

But from Mahableshwar southwards the rainfall is heaviest and the moist ever-green forests predominate. Here the shade, shelter, and abundance of moisture together with an equable temperature and suitable soil have given rise to a luxuriant fern vegetation. Here it is that one sees along the mossy banks of the streams the gigantic tree ferns. Here in the moisture-laden atmosphere are to be found the tiny filmy ferns. In whichever direction the eye gazes it meets with ferns—ferns in great profusion, ferns in great variety, ferns in the rich humus, ferns on the damp rocks, ferns on the trunks of trees—in short, ferns at every point of vantage.

On the plateau of the Deccan, which receives less rain than the Konkan and the Ghats and which has a varied vegetation consisting of arid wastes, grassy expanses, areas of deciduous

shrubland and woodland, there is little scope for a luxuriant fern flora. It is only in the deciduous forests along the Satpura Hills that a good number of ferns occur.

The majority of ferns recorded in this book are moisture-loving and live in the shade of the forest, either in the damp soil rendered rich by vegetable mould or on damp rocks, or again (as epiphytes) on the trunks of trees.

But there are a good number of ferns which prefer open situations and are to be found on hill-sides and grassy places on the outskirts of forests, especially on the lee-ward side of the prevailing winds. Amongst these may be mentioned *Gleichenia linearis* Bedd., *Schizoloma ensifolia* J. Sm., *Adiantum caudatum* L., *Cheilanthes farinosa* Kaulf., *Pteris aquilina* L., *Actiniopteris dichotoma* Bedd. and *Hemionitis arifolia* Bedd. The West Indian *Gymnogramme calomelanos* Kaulf., which is fast becoming naturalized in India, also occurs in similar situations.

Altitude is also a factor that determines the distribution of species. Many ferns occurring at high elevations are not to be found lower down and *vice versa*. Thus *Cheilanthes farinosa* Kaulf. and *Gleichenia linearis* Bedd. have

not been known to exist below 1,000 feet. The lower limit of *Cheilanthes albo-marginata* Clarke, *Actiniopteris dichotoma* Bedd. and *Adiantum caudatum* L. is 2,000 feet. *Adiantum lunulatum* Burm. does not occur above 3,000 feet.

Though a good number of ferns have been found to live in water, there is only one, viz. *Ceratopteris thalictroides* Brong., which can properly claim to be called a water fern, in the sense that it is particularly adapted to live in water by reason of its contained air-spaces and other peculiarities which distinguish aquatic plants.

6. Cultivation of Ferns

In the cultivation of ferns the best rule is to imitate the conditions under which the individual species grow in their native haunts. But as ferns differ considerably in their requirements and it is not possible in an elementary book like this to allude to all of them, we have attempted only to give a few general hints on the cultivation of ferns grown in Bombay. These are mostly tropical and require shade, shelter, abundance of moisture, together with a

suitable soil and temperature. By shade is meant diffuse sun-light, and not absolute shade such as would be obtained under a perfectly thatched roof. The shelter must be such as to protect the plants from strong winds which are injurious to them. Moisture in the soil and in the atmosphere is another requirement, but it must be remembered that absolutely dry soil and a clogged soil are the two extremes to be avoided. The soil must be well drained, and there must be enough of food material available. In many cases ordinary garden soil will do, but an admixture of vegetable mould is always beneficial. On this side of India temperature will present very little difficulty as it is more or less equable.

FERNERIES

In Bombay we grow ferns together with orchids, begonias and other foliage plants in artificial homes known as Ferneries which copy the conditions of climate and soil under which ferns are found in a wild state.

The Bombay Ferneries are of a different sort in character from the more elaborate structures employed for similar purposes in England and

going by the names of conservatories, green houses, hot houses, etc.

The Fernery is a simple shed consisting of a roof supported on posts, bamboos, or rafters. The roof should be so constructed as to allow diffuse sun-light to pass through. Various materials, such as split bamboos, wooden trellis work, chicks, etc. have been employed, but a most useful and at the same time decent roofing is afforded by coir-matting having a mesh varying from half-an-inch to one inch. The Fernery should be enclosed on all sides by wooden trellis work or wire-netting on which creepers can be trained.

The inner arrangement of the Fernery depends on individual tastes, but provision should be made for a few small fountains and a couple of tanks of water which not only add to the beauty of the Fernery but also provide a moist cool atmosphere. There should also be a rockery or two made up of boulders, clinkers or old masonry debris on which many ferns which are otherwise stunted will luxuriate. Ferns may also be grown in pots to advantage. Ordinary garden soil rendered rich by an admixture of leaf mould, debris of decayed wood and charcoal will serve the purpose.

Care should always be taken to see that the pots are well drained by a layer of broken tiles or bricks at the bottom. Epiphytic ferns are best grown in hanging wire baskets in a soil containing a quantity of charcoal and gravel. Many ferns which in their wild state grow on trees or damp rocks thrive well in ordinary soil, while others require, like orchids, to be tied up with moss to pieces of wood or old tree trunks.

CLASSIFICATION

SUB-ORDER I.—GLEICHENIACEÆ

Sori dorsal, without indusium, composed of a few sporangia having a transverse or obliquely transverse complete ring and opening vertically.

Genus I.—Gleichenia R. Br.

(Named after W. F. Von Gleichen.)

Caudex creeping; stipes forked; segments small, almost round or pectinate.

Gleichenia linearis Bedd.

Stipes zig-zag, repeatedly forked, ultimate branches with a pair of forked pinnæ which are cut down almost to the midrib into elongated, entire, blunt segments, bluish-green beneath. A distinct pair of pinnæ arises from the base of the forked branches. [Fig. 6.]

Distribution: Bombay Presidency—North Kanara—Tyagli, Yellapur, Barch, Idagoonji, Nuji, Sumkund, Nilkund, Sirsi, Jog, Hoolgeri, Harshikuta, Herigoota, Katgal, Honawar,

Kasurgode, Bhatkal, Hebunkerri, Castle Rock; Konkan ; Goa Territory, in the neighbourhood of Dood Sagor.

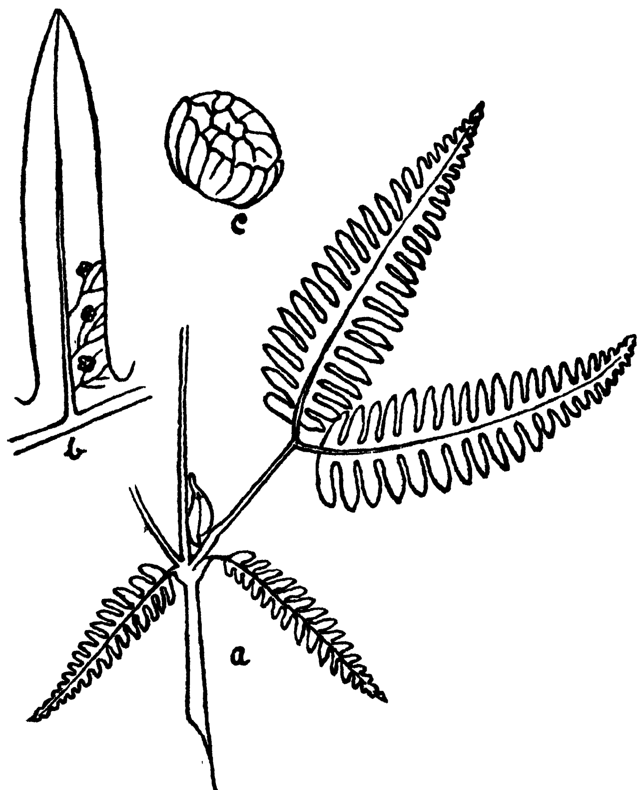


FIG 6.—*Gleichenia līnearis* Bedd.
(*a*) Portion of frond ($\times \frac{4}{5}$).
(*b*) Segment (× 2).
(*c*) Capsule (magnified).

Mountains of Southern India and Ceylon, up to 6,000 feet; Sikkim; Bhotan; Nepal; Kumaon; Khasya, etc. up to 5,000 feet; Malay Peninsula.—Japan; Tropical Australia; America; Polynesia.

SUB-ORDER II.—POLYPODIACEÆ

Sori dorsal or marginal with or without an indusium; sporangia stalked, provided with a vertical more or less complete ring and opening transversely (except in Hymenophylleæ).

(A) *Involucrata*

Sori furnished with an indusium (except in Alsophila).

TRIBE I.—CYATHEÆ

Tree-ferns.—Sori dorsal, round; sporangia stalked or sessile on an elevated receptacle; indusium inferior, in the form of a scale beneath the sorus, or completely enveloping the sorus, ultimately bursting at the top and forming a cup. It is absent in Alsophila.

GENUS II.—CYATHEA

(Deriv. Gr. *Kyathos*, a cup—in allusion to the indusium.)

Caudex arborescent; indusium globose, ultimately rupturing at the apex so as to form a cup holding the sorus.

Cyathea spinulosa Wall.

A tall tree-fern. Stipes and main rachis armed with sharp elevated points. Fronds

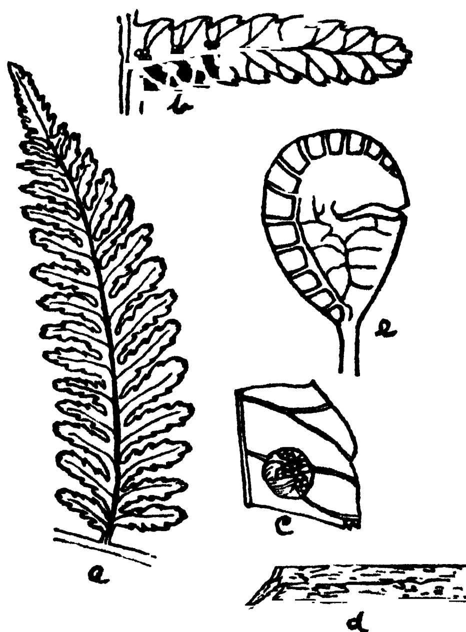


FIG 7 —*Cyathea spinulosa* Wall.
(*a*) A pinnule (nat. size). (*b*) Portion of pinnule (× 3).
(*c*) Portion of segment with a sorus (magnified about 15 times)
(*d*) Portion of rachis. (*e*) Sporangium (magnified).

glabrous, bipinnate; pinnules cut down into elongated serrated segments. Sori on either side of and near the midribs of the segments, indusium globose in the young state, ultimately bursting irregularly at the top. [Fig. 7.]

Distribution: Bombay Presidency—North Kanara—Anmode, Cooesi Hoolgeri, in damp shady places.

. Wynaad at 3,000 feet; South Kanara; Coorg; Jeypoor Hills (Vizag); Nepal; Jaintea Hills.

GENUS III.—ALSOPHILA R. BR.

(Deriv. Gr. Grove-loving.)

Caudex arborescent; sori round, naked.

(Distinguished from Cyathea by the absence of indusium.)

(*a*) Stipes armed with short, blunt or sharp elevated points. Segments narrow. Texture herbaceous. Veins all once forked. Sori occupying nearly the whole segment.

1. *A. latebrosa.*

(*b*) Stipes rough or scaly at the base. Segments triangular or ovate, serrated. Texture leathery to membranaceous. Veins pinnated. Veinlets all simple. Sori arranged in

the shape of an inverted V, not extending to the apex of the segment.

2. *A. glabra.*

1. *A. latebrosa* Hook.

A tree-fern. Stipes armed with short or sharp elevated points. Fronds bipinnate; pinnules gradually tapering from a broad base, cut down almost to the rachis into narrow serrated segments, upper surface naked, lower surface hairy or scaly, the scales being bullate (i.e., puckered) and often mistaken for involucres. Texture herbaceous. Veins all once forked. Sori occupying nearly the whole segment.

Distribution: Bombay Presidency—North Kanara.—A lofty tree-fern

Nilgiris and all the western mountains of the Madras Presidency and the Shevaroys, up to 7,000 feet; Sikkim; Bhotan; Khasya 3,000–5,000 feet; Malay Peninsula; Penang.

2. *Alsophila glabra* Hook.

A tree-fern. Stipes rough, scaly at the base. Fronds bipinnate, tapering from the base, cut down into triangular rounded serrated segments. Texture almost leathery to membranaceous.

Veins pinnated. Veinlets all simple. Sori arranged on the segments in the shape of an inverted V not extending to the apex of the segment. [Fig. 8.]

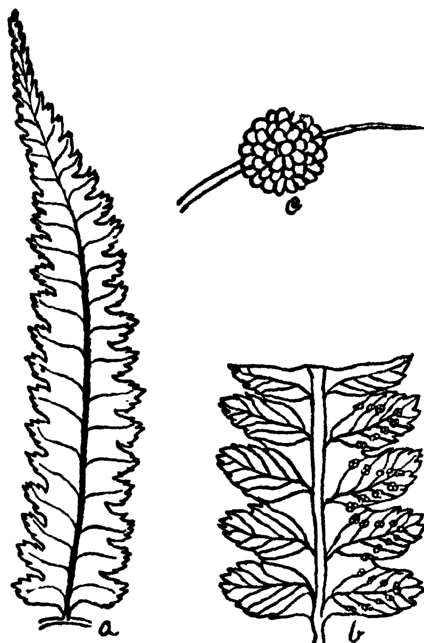


FIG. 8.—*Alsophila glabra* Hook.
(*a*) Pinnule (nat. size). (*b*) Portion of pinnule.
(c) Sorus (magnified).

Distribution: Bombay Presidency—North Kanara—Jog, Barch, Idagoonji, Anmode,

Cooesi, Kumbarwada, Devimunni, Sumkund, Nilkund, Sirsi, Tyagli, Hoolgeri, Munchekerri, Harshikuta, Katgal, Yan.

Western Hills of the Madras Presidency up to 4,000 feet; North Arcot and Cuddapah Hills; Jeypore; Himalayas, very common in Sikkim, Nepal, etc.; Burma and Ceylon.

TRIBE II.—DICKSONIEÆ

Sori round, at the back or apex of a vein; indusium inferior, leathery, mounted on a stalk, covering the whole sorus and bursting irregularly, or cup-shaped, entire or two-lipped. Veins free or anastomosing.

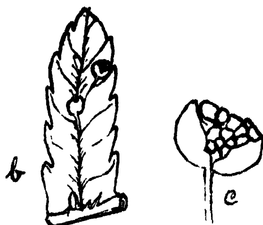
GENUS IV.—PERANEMA DON.

(Deriv. *Peri*, around; *nema*, a thread—in allusion to the thread-like stalk on which the sorus is raised.)

Sori round, arising from the back of a vein or veinlet; indusium inferior, globose, at first enclosing the sorus, ultimately splitting vertically into two lips. Veins free forked, terminating within the margin into clavate (club-shaped) apices.

Peranema cyatheoides Don.

Stipes scaly. Fronds 4–6 feet long, decompound, ultimate pinnules sessile, linear oblong, cut down deeply into narrow segments having a wavy or crenate margin. Rachis and costa of the segments scaly or hairy. [Fig. 9.]



Distribution: Bombay Presidency—In shady places at Mahableshwar.

Nepal and Bhotan, 6,000–10,000 feet; Khasya, 4,500–6,000 feet; Anamalais, 6,000 feet.

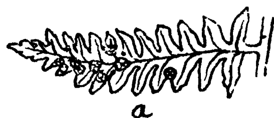


FIG 9—*Peranema cyatheoides* Don.
(*a*) Pinnule (nat. size).
(*b*) Segment (5 times nat. size)
(*c*) Sporangium (magnified).

TRIBE III.—HYMENOPHYLLEÆ

Sporangia globose or ovate, furnished with a transverse ring; indusium inferior, two-valved or tubular. Filmy ferns, usually epiphytic in habit.

GENUS V.—HYMENOPHYLLUM L.

(Deriv. *Hymen*, membrane; *phyllon*, leaf—in allusion to the filmy texture.)

Sori marginal; indusium more or less two-valved; receptacle elongated, columnar, protruding beyond the mouth of the indusium or included within it.

Hymenophyllum polyanthos Sw.

Stipes 2–3½ inches long, wingless or narrowly

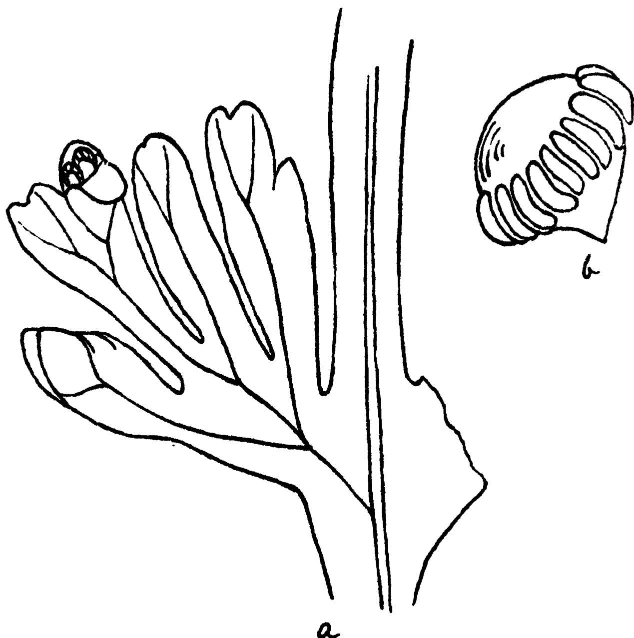


FIG. 10.—*Hymenophyllum polyanthos* Sw.
(*a*) Pinna (× 7).
(*b*) A sporangium (magnified).

winged above. Frond 2–8 inches long, 1–3 inches broad, not crisped, ovate, oblong, three-pinnatifid, main rachis winged; lower pinnæ divided to the winged rachis into several pinnules, on each side, the lowest of which are pinnatifid, with the segments linear. Sori more or less terminal on the segments; indusium distinctly two-valved, the valves ovate or rounded. [Fig. 10.]

Distribution: Bombay Presidency—Castle Rock.

Western Ghats of the Madras Presidency; Ceylon; Himalayas and Khasya mountains, 4,000–12,000 feet; Burma.

GENUS VI.—TRICHOMANES SMITH

(Deriv. *Thrix*, hair; *manos*, soft.)

Sori always terminating a vein, more or less sunk in the frond; indusium tubular or slightly two-lipped; receptacle elongated, columnar, often considerably protruding beyond the mouth of the indusium.

(*a*) Fronds entire below, palmate or digitate above.

1. *T. kurzii.*

(*b*) Fronds more or less deeply pinnatifid, but not truly pinnate :—

(*i*) Main rachis distinctly winged throughout; indusium cylindrical, tapering at the base ; receptacles protruding.

2. *T. intermarginale.*

(*ii*) Main rachis hardly, if it all, winged in the lower part. Indusium tubular, mouth very distinctly two-lipped.

3. *T. bipunctatum.*

1. *Trichomanes kurzii* Bedd.

Rhizome slender, creeping. Stipe very short. Frond less than an inch long, pinnatifid with the segments one to three-lobed ; ultimate segments linear. Surface somewhat wavy ; margin bounded by a thickened line. Texture thick. Veins a single midrib to each segment. Sori terminal ; indusium sunk in the frond, top-shaped, with the mouth dilated but without lips.

Distribution : Bombay Presidency—North Kanara—Godhulli, Anshighat, at no great elevation. Found on moist trunks of trees during the monsoon.

Malabar, foot of the Tambacherry Ghat; Assam; Andaman Islands.

2. *Trichomanes intermarginale* Hook. and Grev.

Rhizome slender, creeping, hairy. Stipe short. Frond 1–2 inches long, ¼–½ inch broad, pinnatifid with a few segments which are simple, forked or pinnate; apices of segments notched. Texture almost leathery. Margin thickened. Veins a single midrib in each segment. Sori terminal; indusium almost cylindric, tapering at the base, entirely sunk in the frond; receptacle protruding beyond the mouth of the indusium. [Fig. 11.]

Distribution: Bombay Presidency—North Kanara—Devimunni. On moist rocks and ground in shady places by the banks of streams.

Malabar plains; foot of Bhagamandal Ghat which descends from Coorg; Sivagiri Hills (Tinnevelly district); Ceylon, in the Ambagamwa district.

3. *Trichomanes bipunctatum* Poir.

Rhizome slender, creeping. Stipes 1–2 inches long, naked, slightly winged above. Frond 1–4 inches long, 1½–2 inches broad, ovate, three-pinnatifid, main rachis narrowly winged or

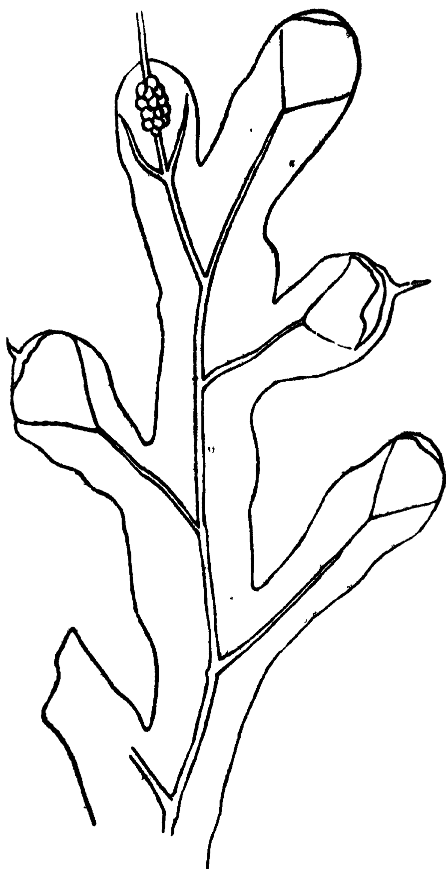


FIG. 11.—*Trichomanes intermarginale* Hook. and Grev.

free below, pinnæ pinnatifid down to a narrowly winged rachis; ultimate segments linear. Texture firm, membranaceous. Veins a central costa in each segment, spurious venules none or indistinct. Sori terminal; indusium tubular, sunk or somewhat protruding; mouth very distinctly two-lipped with the lips almost triangular.

Distribution: Western forests of the Bombay Presidency.

Western forests of the Madras Presidency, up to 8,000 feet; Ceylon; Himalayas and Khasya hills up to 6,000 feet. Throughout the tropics of the whole world.

TRIBE IV.—DAVALLIEÆ

Sori rounded or oblong, situated at or near the margin; indusium adherent at the base, open at the apex, i.e. exteriorly, open or free at the sides.

GENUS VII.—LEUCOSTEGIA PRESL.

(Deriv. Gr. *Leucos*, white; *stegos*, a cover.)

Indusium small, narrow, thin, fixed only by its broad base. Rhizome creeping, stipe articulated with the rhizome.

(*a*) Rhizome creeping, downy or covered with fibrillose scales. Pinnules cut down into roundly lobed finely crenate segments. Texture herbaceous.

1. *L. immersa.*

(*b*) Rhizome creeping; covered with blunt often peltate scales. Pinnules cut down to a narrowly winged rachis into very narrow linear sharply pointed segments. Texture almost leathery.

2. *L. pulchra.*

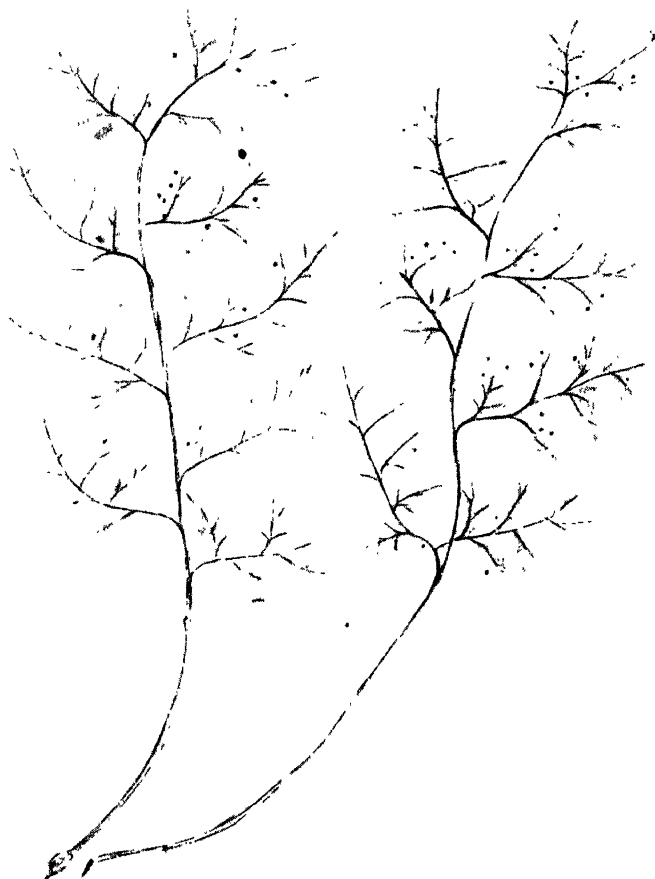
1. *Leucostegia immersa* Presl.

Rhizome creeping, downy or covered with fibrillose scales. Fronds three-pinnate, triangular, 12–18 inches long, 6–9 inches broad; pinnules cut down into broad segments, excised at the base below and roundly lobed, with the lobes crenulate above. Surfaces naked. Texture thin. Sori large, close to the margin. [Plate V-*a*.]

Distribution: Bombay Presidency—Mahableshwar; on trees and banks, Lonavla.

Madras Presidency on the western mountains; Coorg; Himalayas, from Mussorie to Bhotan, 3,000–6,000 feet; Sikkim; Khasya; Malay Peninsula.—Java.

PLATE V-a



Leucostegia immersa Presl.

2. *Leucostegia pulchra* J. Sm.

Rhizome creeping, covered with blunt often peltate scales. Stipes scaly below. Frond

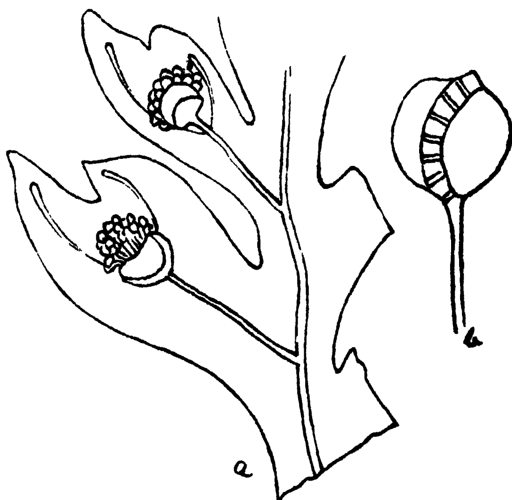


FIG. 12.—*Leucostegia pulchra* J. Sm.
(*a*) Pinnule with two sori (× 7). (*b*) Sporangium (magnified).

triangular-lanceolate, 9–10 inches long, 4–8 inches broad, 3–4 pinnate ; pinnules cut down to a narrowly winged rachis into very narrowly linear sharply pointed segments. Texture almost leathery. Sori at the base of the teeth of the segments. [Fig. 12.]

Distribution : Bombay Presidency—Mahableshwar on trees ; Lonavla on trees ; Khandala.

Madras Presidency, on the western mountains; Ceylon, Central Provinces 3,000–5,000 feet; Himalayas, Nepal and Bhotan, 2,000–9,000 feet; Khasya; Moulmein.

GENUS VIII.—DAVALLIA SM.

(Deriv. after Davall, a Swiss Botanist.)

Indusium leathery, attached at sides and base, half cup-shaped. Rhizome creeping, stipe articulated with the rhizome.

(*a*) Sori half cup-shaped with usually a horn on the outside.

1. *D. bullata.*

(*b*) Sori half-cylindrical with no horn.

2. *D. fijiensis.*

1. *Davallia bullata* Wall.

Rhizome creeping, covered with hair-pointed scales. Frond triangular, 8–12 inches long, 4–8 inches broad, four-pinnatifid with deeply incised segments. Texture leathery. Sori half cup-shaped, marginal and with usually a horn on the outside. [Fig. 13.]

Distribution: Bombay Presidency—Western Ghats.

Western Ghats of the Madras Presidency; Himalayas, Nepal to Bhotan, 2,000–6,000 feet;

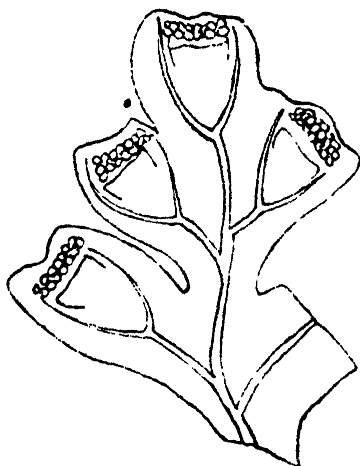


FIG. 13.—*Davallia bullata* Wall.
A pinnule (× 7).

Khasya; Ceylon; Burma; Malay Peninsula.—Japan; South China; Malay Islands.

Also grown in gardens.

2. *Davallia fijiensis* H. K.

Rhizome thick, creeping, densely covered with fibrillose scales. Frond triangular, 12–18 inches long, 6–12 inches broad, four-pinnatifid, pinnules of the lower pinnæ triangular-elongated, segments cut into narrow linear divisions

$\frac{1}{8}$–$\frac{1}{4}$ of an inch long. Texture leathery. Sori half-cylindrical with no horn.

Distribution: Fiji Islands, plentiful.

Cultivated in Bombay gardens. A very fine species.

Genus IX.—Microlepia Presl.

(Deriv. Gr. *Micros*, small; *lepis*, scale—in allusion to the small indusium.)

Indusium membranaceous, half cup-shaped, attached at the sides and base. Rhizome creeping; stipe continuous with the rhizome.

(*a*) Surfaces hairy when young, naked when adult. Ultimate segments broad, bluntish toothed, oblong triangular.

1. *M. platyphylla.*

(*b*) Surfaces hairy, pinnules or ultimate segments rhomboidal.

(*i*) Frond bipinnate, lanceolate; indusium hairy.

2. *M. strigosa.*

(*ii*) Frond 3–4 pinnatifid, ovate or triangular; indusium hairy or naked.

3. *M. speluncæ.*

1. *Microlepia platyphylla* J. Sm.

Rhizome thick, creeping. Stipes erect. Fronds 3–4 feet long, three-pinnatifid; pinnæ large, spreading, ovate, elongate in form with the apices acuminate; ultimate segments broad, bluntish toothed, oblong triangular. Surfaces hairy when young, naked when adult. Texture leathery. Sori one in each tooth of the segment. [Fig. 14.]

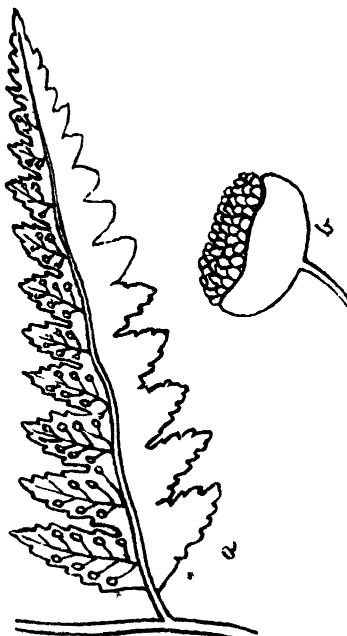


FIG. 14.—*Microlepia platyphylla* J. Sm.
(*a*) A pinnule (× ½)
(*b*) A sorus (magnified).

Distribution: Madras Presidency throughout the western mountains, up to nearly 6,000 feet; Ceylon; Himalayas, Nepal, Sikkim, Bhotan 3,000–5,500 feet elevation; Khasya.

Occurs in Bombay only in cultivation.

2. *Microlepia strigosa* Moore

Frond bipinnate; pinnules oblong, rhomboidal, rather bluntly toothed. Veins hairy on both sides; rest of the surface hairy or naked. Rachis hairy. Indusium half cup-shaped, hairy.

Very much like M. speluncæ, except that it is never more than bipinnate.

Cultivated.

Distribution: Tinnevelly and Travancore mountains, South India; Ceylon; Himalayas; Malay Peninsula—Japan; South China; Sandwich and Fiji Islands.

3. *Microlepia speluncæ* Bedd.

Rhizome short, creeping. Stipes 1–1½ foot long. Fronds up to six or more feet long, triangular to ovate, 3-4 pinnatifid. Ultimate segments rhomboidal, almost entire or slightly crenated (or more or less deeply cut). Surfaces hairy or almost naked. Texture membranaceous. Sori half cup-shaped with the indusium hairy or naked. [Fig. 15.]

Distribution: Bombay Presidency—North Kanara—Jog, Gersoppa Ghat, Yan; Bombay Island—Sion Wood.

Western mountains of the Madras Presidency; Ceylon; Himalayas from Kumaon



FIG. 15.—*Microlepia speluncæ* Bedd.
(*a*) A pinnule (nat. size). (*b*) A segment (× 3).
(*c*) A sorus (magnified).

eastwards; Khasya; Chittagong; Malay Peninsula—China; Japan; Malay Islands; Polynesia; Tropical America.

Also cultivated.

Specimens from North Kanara are very large and three-pinnate. Those collected in gardens and in Sion Wood are much smaller and only two-pinnate. The Sion ones are probably escapes from cultivation.

GENUS X.—STENOLOMA FEE

(Deriv. *Stenos*, narrow ; *loma*, border.)

Indusium forming a compressed, almost round or cup-shaped pouch, only open at the top. Rhizome creeping; stipes tufted, not articulated upon the rhizome.

Stenoloma chinensis Bedd.

Rhizome short, creeping, covered with fibrillose scales. Stipes glossy, naked, polished. Fronds triangular to ovate, 12–18 inches long, 6–9 inches broad, four-pinnatifid; pinnæ and pinnules triangular or ovate, elongate; ultimate segments wedge-shaped, narrowed from tip to base. Surfaces naked. Texture almost leathery. Sori confined to the tips of the segments.

Distribution: Bombay Presidency—North Kanara—Sumkund, Tyagli, Nilkund, Hoolgeri, Harshikuta, Castle Rock on earth banks.

Madras Presidency, western mountains 3,000-6,000 feet; Himalayas, Kumaon to Bhotan, up to 1,000–4,000 feet; Khasya; Ceylon; Malay Peninsula—China; Japan; Polynesia; East African Islands.

TRIBE V.—LINDSAYEÆ

Sori placed in a line at or near the margin of the frond at the apex of and uniting two or

more veinlets. Indusium double, i.e. formed of two valves, the inner of which is membranaceous, the outer formed of the slightly changed margin of the frond.

GENUS XI.—LINDSAYA DRYAND

(After Lindsay, a writer on ferns.)

Veins forked, free; pinnæ unequal-sided or equal-sided.

Lindsaya cultrata Sw.

Rhizome short, creeping, wiry, scaly. Stipes wiry. Fronds 6–12 inches long, about an inch broad, pinnate; pinnæ stalked or sessile, unequal sided; lower edge, straight; upper more or less lobed or entire. Texture leathery. [Fig. 16.]

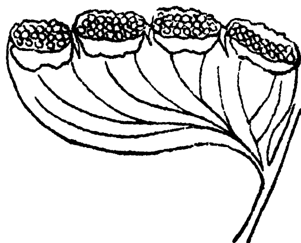


FIG. 16.—*Lindsaya cultrata* Sw. Pinna (× 4).

This fern has the habit of Adiantum. It is called the hay-scented fern from its scent when drying.

Distribution: Bombay Presidency—North Kanara.

Very common on the western side of the Madras Presidency, up to 6,000 feet; Ceylon;

Himalayas, Nepal to Mishmee and Chittagong up to 4,000 feet; Burma; Malay Peninsula—North Australia; Formosa; Japan; Malay Islands; East African Islands.

GENUS XII.—SCHIZOLOMA GAUD.

(Deriv. Gr. *Schizo*, I cut; *loma*, margin.)

Veins more or less uniting. Pinnæ unequal-sided or equal-sided.

(*a*) Pinnæ unilateral (unequal-sided).

1. S. *lobata*.

(*b*) Pinnæ equilateral (equal-sided).

(*i*) Frond pinnate. Pinnæ rarely reduced to one, 1½–6 inches long, ¼–1 inch broad, gradually tapering from a broad unequal base.

2. S. *ensifolia*.

(*ii*) Frond pinnate with large linear-lanceolate pinnæ or bipinnate, occasionally tripinnate; pinnules ½–1 inch long, ¼ inch broad, entire or unequally lobed.

3. S. *heterophylla*.

1. *Schizoloma lobata* Poir.

Rhizome short, creeping. Fronds pinnate or bipinnate; pinnules about ½ inch long, ¼ inch broad, curved up, unequal-sided; lower margin entire; upper rather deeply lobed. Texture thin, herbaceous. Sori on the lobes.

Distribution: Bombay Presidency—North Kanara—Jog and Gersoppa Ghat.—Malabar and Travancore mountains; Ceylon—Queensland, Polynesian Islands.

2. *Schizoloma ensifolia* J. Sm.

Rhizome creeping, scaly. Stipes wiry. Fronds 6–12 inches long, 3–4 inches broad; pinnate, rarely reduced to 1, 1½–6 inches long, ¼–1 inch broad, gradually tapering from a broad unequal base, slightly toothed at the margin where sterile; veins forming a net-work; sori continuous along the margin. [Fig. 17.]

Distribution: Bombay Presidency—North Kanara—Idagoonji, Nuji, Anshi, Devimunni, Sumkund, Nilkund, Hoolgeri, Herigooti, Katgal, Honawar, Kasurgode, Bhatkal, Castle Rock; Mahableshwar.

Western mountains of Madras; Ceylon; Himalayas, Sikkim to Muneypore and Chittagong up to 4,000 feet; Burma—North Australia;

Tropical Africa; East African Islands; Polynesia.

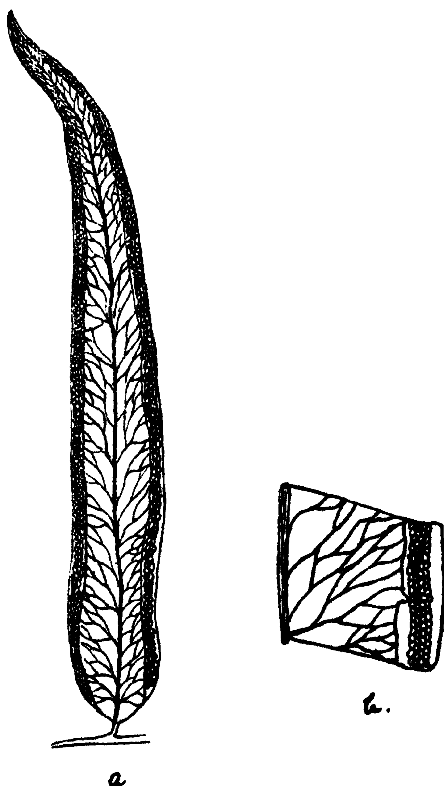


FIG. 17.—*Schizoloma ensifolia* J. Sm.
(*a*) Pinna (nat. size). (*b*) Portion of pinna (× 2½).

3. *Schizoloma heterophylla* J. Sm.

Rhizome creeping. Fronds 6–12 inches long, 3–6 inches broad, pinnate with large linear-lanceolate pinnæ or bipinnate, occasionally tripinnate; pinnules ½–1 inch long, ¼ inch broad, entire or unequally lobed. Texture herbaceous. Sori more or less continuous along the margin. [Fig. 18.]

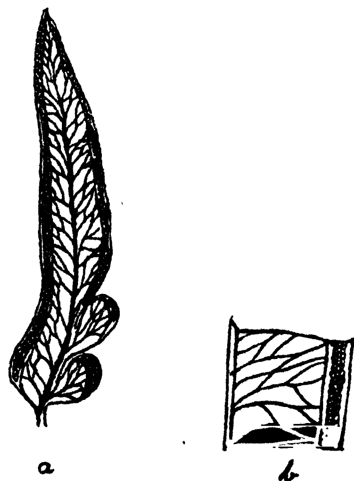


FIG. 18.—*Schizolom a heterophylla* J. Sm.
(*a*) Pinna (nat. size).
(*b*) Portion of pinna (× 1½).

Distribution: Bombay Presidency—North Kanara common, Sumkund, Katgal, Arbail Ghat.

Malabar mountains, Travancore; Ceylon; Malay Peninsula—Mauritius; Hongkong; Malay Islands.

TRIBE VI.—PTERIDEÆ

Sori marginal, oblong or in a line. Indusium formed of a more or less changed and

reflexed margin of the frond opening inwardly.

GENUS XIII.—ADIANTUM L.

(Deriv. Gr. *Adiantos*, dry; from the curious property of repelling moisture.)

Sori marginal, rounded or in a line, usually numerous and distinct, sometimes confluent and continuous, bearing the sporangia on the underside; veins free.

(*a*) Radicantes Group.—Frond simply pinnate, rachis rooting at the apex.

(*i*) Pinnæ half-moon shaped, distinctly stalked, ¾–½ inch by 1½–1 inch. Texture herbaceous.

1. *A. lunulatum*.

(*ii*) Pinnæ wedge-shaped at the base, nearly sessile, ½–¾ inch by ¼ inch. Texture leathery.

2. *A. caudatum*.

(*b*) Polysorous Group.—Frond once or more pinnate; sori numerous, roundish, oblong or transversely kidney-shaped.

(*i*) Ultimate segments not dimidiate (i.e. halved or appearing as if one half had been cut off), but having two or more distinctly opposite rows of sori.

3. *A. peruvianum.*

(*ii*) Ultimate segments dimidiate.

(1) Stems naked and polished. Ultimate pinnules 1½–2 inches lng. Texture thin.

4. *A. trapeziforme.*

(2) Stems hairy, rough. Ultimate pinnules ½–¾ inch long. Texture almost leathery.

5. *A. formosum.*

(*c*) Oligosorous Group.—Frond once or more pinnate. Sori more or less continuous on either side of the leaflet.

6. *A. macrophyllum.*

(*d*) Capillus-Veneris Group.—Frond at least bipinnate; segments fan-shaped with the stalk near the centre; sori oblong or obversely kidney-shaped.

(I) Fronds longer than broad.

(*i*) Sori roundish or transversely oblong.

1. Pinnules distinctly wedge-shaped at the base. Sori in shallow depressions of the lobes.

(1) Pinnules deciduous.

7. *A. tenerum.*

(2) Pinnules not deciduous.

8. *A. capillus veneris.*

2. Pinnules roundish, being straight, almost wedge-shaped or rounded at the base. Sori in deep hollows of the lobes.

9. *A. aethiopicum.*

(*ii*) Sori obversely kidney-shaped in deep round hollows of the lobes.

1. Pinnules distinctly crenate at the base.

(1) Frond 3–4 pinnate. Pinnules $\frac{1}{4}$–$\frac{3}{8}$ inch broad.

10. *A. cuneatum.*

(2) Frond at least four-pinnate. Pinnules $\frac{1}{8}$–$\frac{1}{4}$ inch broad.

11. *A. gracillimum.*

2. Pinnules rhombic in shape (being obliquely wedge-shaped at the base).

12. *A. concinnum.*

(II) Fronds about as broad as long.

13. *A. collisii.*

(*e*) Pedatum Group.—Frond not pinnately branched but dichotomously forked with numerous pinnæ springing from the upper side of each of the branches.

14. *A. hispidulum.*

1. *Adiantum lunulatum* Burm.

Stipes 4–6 inches long, black to brown, wiry, polished. Fronds often rooting at the tip, 6–12 inches long, 3 inches broad, pinnate, pinnæ distinctly stalked, half-moon shaped, $\frac{3}{4}$–1$\frac{1}{2}$ inches broad, $\frac{1}{2}$–1 inch deep, frequently lobed. Rachis on both surfaces naked. Texture herbaceous.

Sori linear, frequently becoming confluent. [Fig. 19.]

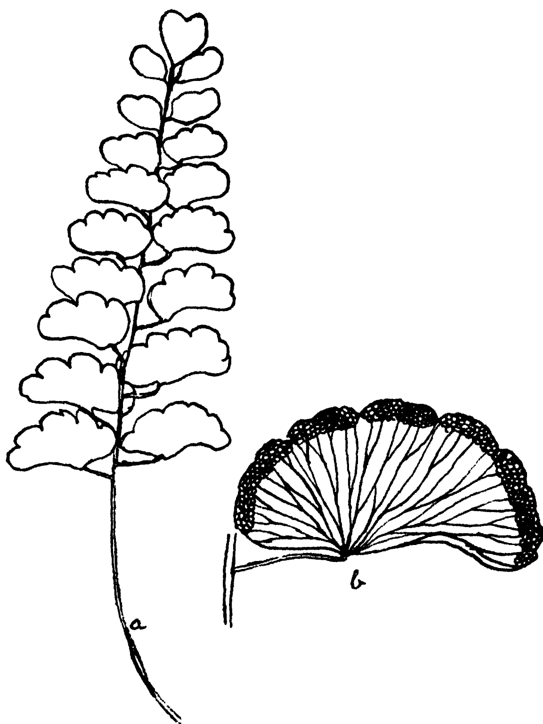


FIG. 19.—*Adiantum lunulatum* Burm.
(*a*) Small frond (nat. size) (*b*) Large pinna (nat. size).

Distribution: Bombay Presidency—North Kanara common, Castle Rock; Panchgani,

Mahableshwar; Lonavla, Purandhar, Khandala; Nasik district: Lena Hill, Igatpuri Ghats, Igatpuri; Khandesh, north slope of Chanseli; Savantwadi State, Vetora; Goa territory; Konkan, Matheran; Bassein and Bassein Range; Bombay Island, Sion, Sewrie, Mahaluxmi; Salsette, Bandra, Coorla, Mulgaum, Conditta, Bhandup, Vehar Lake, Tulsi Lake, Keneri Caves, Thana, Versova, Trombay Hill.

Throughout Northern India in moist places; South India, general on the western side and lower slopes of the hills; Ceylon; Burma—in the tropics of nearly the whole world.

The fern dies down after the rains.

The vernacular name is Rata Kombada, also Kombada. Used in making bracelets by the wild tribes. It is a very graceful fern and would do well in a fernery.

2. *Adiantum caudatum* L.

Stipes and rachises brown, polished, hairy. Fronds 6–12 inches long, often rooting at the tip, pinnate, pinnæ nearly sessile, ½–¾ inch by ¼ inch, wedge-shaped at the base, deeply cut into several narrow spreading lobes. Surfaces

hairy. Texture as a rule leathery. Sori on the edge of the lobes, nearly round. [Fig. 20.]

Distribution: Bombay Presidency—Southern parts in the higher Ghats; Purandhar; Satara district, Shirgaon Ghat; Nasik district, Lena Hill; Khandesh, north slope of Chanseli.

Throughout India, Ceylon, and the Malay Peninsula, in the plains and on lower slopes of the hills—South China; Malay Islands, Java; Mauritius; Tropical Africa; Cape Verde Islands.

Also cultivated.

The variety *edgeworthii* Bedd. of Northern India, with the pinnæ and rachis naked and pinnæ less cut, has been recorded by Lowe in his *Ferns, British and Exotic*, to occur in Sind; elsewhere in the Presidency it has not yet been found.

3. *Adiantum peruvianum* Klotzch

Stipe 6–9 inches long, strong, erect, black polished, naked. Fronds simply pinnate, or the lower branches again pinnate or bipinnate; ultimate pinnules two inches or more broad, 1½ inches deep, obliquely ovate, base wedge-shaped, apex often long, pointed, upper and outer sides

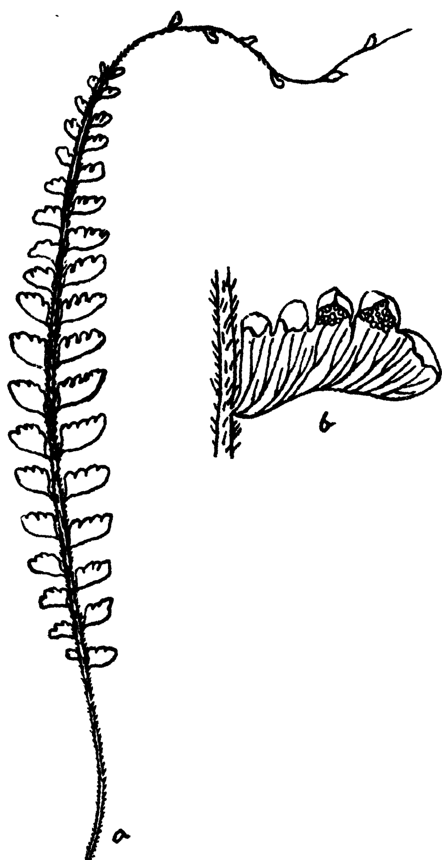


FIG. 20.—*Adiantum caudaium* L.
(*a*) Frond (× ⅓). (*b*) Pinna (× 2).

slightly lobed, with the lobes serrate; rachis and surfaces naked. Texture papery, herbaceous. Sori in elongated patches on the lobes. [Fig. 21.]

Distribution: Peru.

Common in gardens.

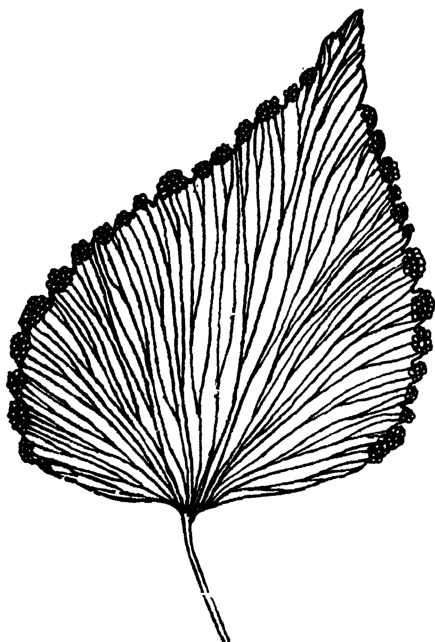


FIG. 21.—*Adiantum peruvianum* Klotzch. Pinnule (nat. size).

4. *Adiantum trapeziforme* L.

Rhizome short, creeping. Stipe scaly at the very base, otherwise black, polished, naked.

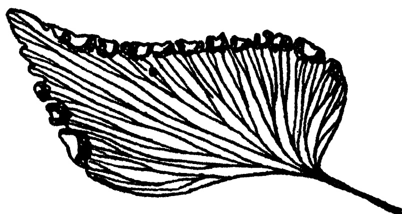


FIG. 22.—*Adiantum trapeziforme* L.
Pinnule (nat. size).

Frond up to 4 feet high, 3–2 pinnate, central pinna the largest, ultimate pinnules 1½–2 inches long, ½–¾ inch broad, ovate-rhomboidal or trapezoid, long-pointed with the upper and outer edge bluntly lobed; rachis and surfaces naked. Texture papery, herbaceous. Sori on the upper and outer edge large, oblong. [Fig. 22.]

Distribution: West Indian Islands, Jamaica, Cuba, Mexico, Central America, Caraccas, Brazil, Vera Cruz and Guatamala.

Very commonly cultivated.

5. *Adiantum formosum* R. Br.

Stipe black, glossy, rough, 12–18 inches long. Frond 1½–2 feet long, about two-thirds broad,

3–4 pinnate, ultimate pinnules ½–¾ inch long, wedge-shaped at the base, upper edge rounded and deeply lobed with the lobes serrate when sterile; rachis rough, hairy. Texture almost leathery. Sori numerous, placed on the edge of the lobes, transversely oblong with kidney-shaped indusia. [Fig. 23.]

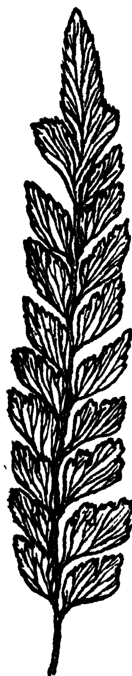


FIG. 23.—*Adiantum formosum* R. Br. Pinnule (nat. size).

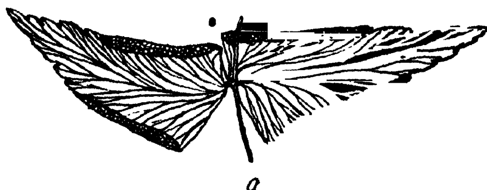
Distribution: Temperate Australia and New Zealand. Cultivated.

6. *Adiantum macrophyllum* Sw.

Rhizome creeping. Stipe black, polished, naked. Frond up to 18 inches long, pinnate; pinnæ 4–6 pairs, large, 4 inches by 2 inches, almost sessile, ovate, acute, pointed, with the margin lobed, fertile pinnæ narrower; rachis and surfaces naked. Texture thin, membranous. Sori in continuous lines or slightly interrupted on either side of the pinna. [Fig. 24.]

Distribution: West Indies and Tropical America, Mexico and Jamaica.

Cultivated.



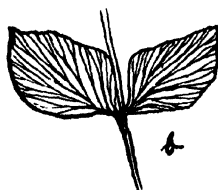


FIG. 24.—*Adiantum macrophyllum* Sw.

(*a*) Portion of fertile frond ($\times \frac{1}{3}$). (*b*) Portion of sterile frond ($\times \frac{1}{2}$).

7. *Adiantum tenerum* Sw.

Rhizome creeping. Stipe about a foot long, black, polished, naked except at the very base

which is scaly. Frond 1–3 feet long, 9–18 inches broad, triangular, 3–4 pinnate; pinnules ½–¾ inch broad, wedge-shaped at the base, more or less rounded at the outer edge, rather deeply lobed, lobes finely serrate when sterile; rachis and surfaces naked. Texture thin to almost leathery. Sori on the lobes rather roundish or transversely oblong. [Fig. 25.]

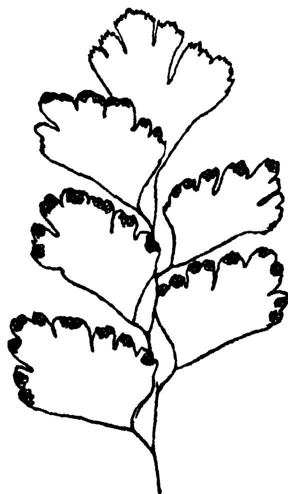


FIG. 25.—*Adiantum tenerum* Sw. Pinnules (nat. size).

Distribution: Mexico and West Indian Islands, southwards to Juan Fernandez and Peru.

One solitary specimen was collected in Sion Wood, Bombay Island. It is evidently an escape from cultivation.

The following horticultural varieties occur in the Bombay gardens :—

1. Var. *bausei*.—Pinnules drooping, almost leathery.

2. Var. *farleyense*.—Fronds drooping; pin-

nules closely overlapping, base wedge-shaped with curved sides, outer margin rounded, very deeply and narrowly cut. Texture thin. We have not seen this variety in fruit. [Fig. 26.]

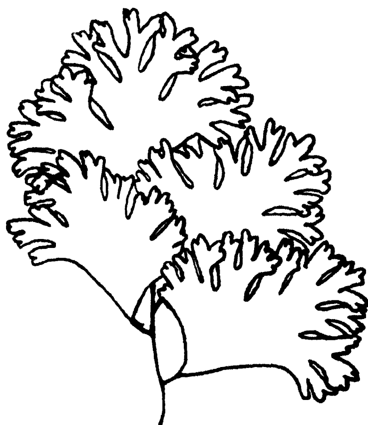


FIG. 26.—*Adiantum tenerum* Sw. var. *farleyense*. A few pinnules (nat. size).

8. *Adiantum capillus veneris* L.

Rhizome creeping, densely scaly. Stipes scaly, purplish black and polished. Fronds 2–3 pinnate; ultimate pinnules ½–1 inch broad, obliquely fan-shaped with the upper edge irregularly rounded, sometimes broadly lobed, lobes finely toothed when sterile; rachis and

surfaces naked. Sori roundish or obversely kidney-shaped. [Fig. 27.]

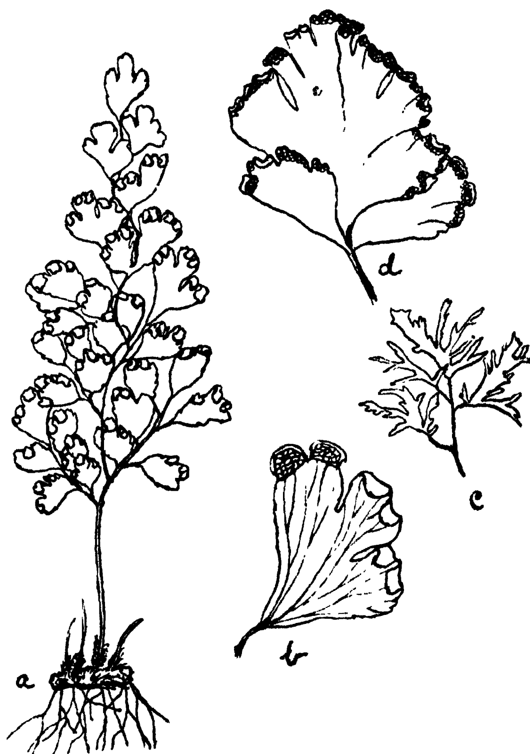


FIG. 27.—*Adiantum capillus veneris* L.
(*a*) A small plant (nat. size). (*b*) A pinnule (× 2)
(c) Var. *mariesii*, portion of frond (nat. size).
(*d*) Var. *fergusoni*, pinnule (nat. size).

Distribution: Bombay Presidency—Panchgani, on wet rocks; Mahableshwar; Pashan Tank, six miles from Poona; Purandhar; Nasik district, Nasik road in wells, Gungapur, Adgaon (along brook), Dindori (on the wall of irrigation canal), Igatpuri Ghats; Khandesh, Dadgaon; Gujerat; Sind; Bombay Island, Sewrie, Mahim, very common in wells in the coconut groves; Salsette Island, Versova, in wells and conduits in the coconut groves; Goa territory, in damp places near Dood Sagor.

Madras Presidency, west side, common on banks of rivers in the plains, and up to 5,000 feet; Ceylon; North India.—Europe; Africa; America; Australia.

Common in gardens. The True Maiden Hair.

The variety *mariesii* of gardens has leaflets laciniate (cut into narrow lobes). The variety *fergusoni* seems to have arisen as a sport in a garden in Ceylon. It is a large Fern with pinnules about an inch across and deeply lobed, the lobes overlapping each other.

9. *Adiantum æthiopicum* L.

Rhizome creeping, scaly. Stipe dark brown. Fronds triangular in outline up to 18 inches

long, 6–9 inches broad; pinnules $\frac{1}{4}$–$\frac{1}{2}$ inch broad, straight, almost wedge-shaped or rounded at the base and deeply lobed upper border; rachis and surfaces naked. Texture thin, herbaceous. Sori roundish or transversely oblong.

Like *Adiantum capillus veneris*, but the pinnules are broadly wedge-shaped at the base.

Distribution: Bombay Presidency—North Kanara, Supa, rare.

Nilgiri and Pulney mountains at the higher elevations; Ceylon.—Australia; New Zealand; America; Africa; East African Islands.

10. *Adiantum cuneatum* Langs. and Fisch.

Stipe 6–9 inches long, slender, black, naked, polished. Frond up to 18 inches long, 6–9 inches broad, triangular, 3–4 pinnate; pinnules $\frac{1}{4}$–$\frac{3}{8}$ inch broad, wedge-shaped at the base, rounded at the outer edge with crenated lobes; rachis and surfaces naked. Texture thin. Sori 4–6 on a pinnule situated in hollows of the lobes, indusium kidney-shaped. [Fig. 28.]

Distribution: Brazil.

Very common in cultivation and runs into many varieties, very difficult to identify.

11. *Adiantum gracillimum* Moore

Frond about a foot or more long, triangular, at least four-pinnate; pinnules very minute, $\frac{1}{8}$–$\frac{1}{4}$ inch wide, base wedge-shaped, outer side round-

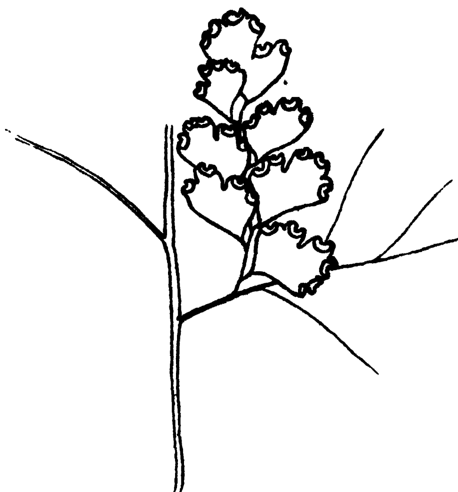


FIG. 28.—*Adiantum cuneatum* Langs. and Fisch.
Part of frond (nat. size).

ed and lobed with the lobes somewhat serrate. Sori in hollows of the lobes, large, kidney-shaped.

A very pretty fern. It is of horticultural origin and is perhaps a variety of *Adiantum cuneatum*.

12. *Adiantum concinnum* H. B. K.

Rhizome somewhat creeping. Stipe 4–8 inches long, black polished, naked. Frond 1–1½ feet long, 6–9 inches broad, ovate, triangular, 2–3 pinnate; pinnules rhomboidal, ¼–⅜ inch across, obliquely wedge-shaped at the base, outer edge more or less rounded and lobed with the lobes entire, crenate or blunt; rachis and surface naked. Texture membranaceous. Sori kidney-shaped, placed in hollows on the lobes. [Fig. 29.]

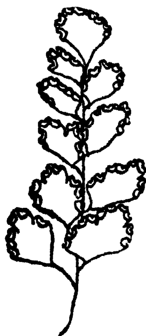


FIG. 29.—*Adiantum concinnum* H. B K Pinnule (nat size)

Distribution: Tropical America from Mexico to West Indies, southwards to Peru and Brazil.

Cultivated.

13. *Adiantum collisii* Moore

Stipe and rachis black, polished, naked. Frond about as long as broad, at least four-pinnate; pinnules up to ½-inch broad, wedge-shaped at the base, outer edge rounded and deeply lobed with the lobes finely serrate.

Rachises apparently repeatedly forked. Sori transversely oblong, indusium kidney-shaped.

Occurs in the Bombay gardens. Of garden origin.

14. *Adiantum hispidulum* Sw.

Stipe and rachis black polished, rough with stiff close hairs. Frond forked, the two divisions branching in a fan-like manner; largest pinnæ 6–9 inches long, ultimate pinnules about ¼-inch or more, bluntly oblong, wedge-shaped at the base and crenate on the margins; surfaces hairy. Texture almost leathery. Sori small, kidney-shaped on the outer and upper edge. [Fig. 30.]

Distribution: Common in the western hills of the Madras Presidency, 3,000–5,000 feet; Ceylon up to 4,000 feet.—Australia, New Zealand; Fiji; Africa; East African Islands.

GENUS XIV.—CHEILANTHES Sw.

(Deriv. Gr. *Cheilos*, lip; *anthos*, flower—in allusion to the marginal sori.)

Indusium roundish and distinct, or more or less confluent, but not continuous, sporangia on underside of the frond, veins free.

(*a*) Frond two-pinnatifid, more or less covered with white or yellow meal beneath.

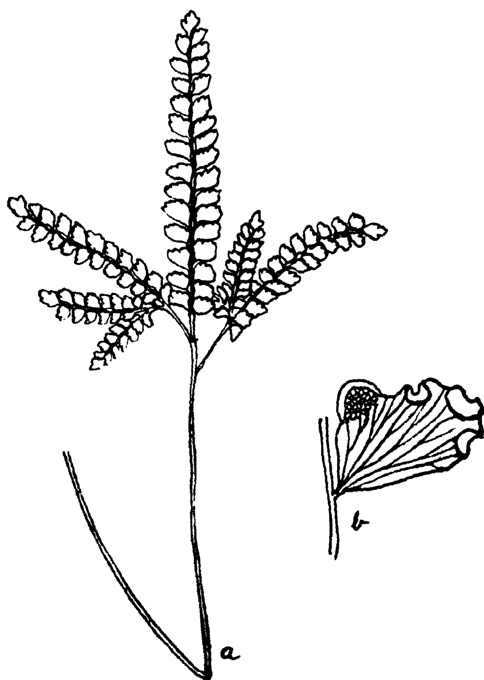


FIG. 30.—*Adiantum hispidulum.*
(*a*) Frond (× ½). (*b*) Pinnule (× 3)

(*i*) Stipes only scaly. Scales evenly coloured. Indusium entire, even or toothed.

1. *C. farinosa.*

(*ii*) Stipes, rachis and costæ scaly. Scales pale-margined. Indusium lacerate.

2. *C. albomarginata.*

(*b*) Frond three-pinnatifid, not covered with meal beneath.

3. *C. tenuifolia.*

1. *Cheilanthes farinosa* Kaulf.

Rhizome creeping, stout, scaly. Stipes reddish brown to black polished, naked or scaly near the base (scales evenly coloured). Fronds triangular or lanceolate-triangular in outline, bi-pinnatifid, varying in size, basal pinnæ auricled below; under side thinly or thickly coated with white meal; upper side naked. Rachis naked. Texture varying from membranaceous to leathery. Indusium entire, even or toothed. [Fig. 31 and Plate VI.]

Distribution: Bombay Presidency—North Kanara—Nidgod; Deccan—Mahableshwar, Panchgani, Sakar Pathar, Lonavla, Khandala; Konkan, Matheran; Parsik Hill near Thana, Igatpuri; Turanmal (W. Khandesh); northern slope of Chanseli (Khandesh); Trombay Hill, near Bombay.

Throughout North India, in the hills up to 5,000 feet; Madras Presidency, in the plains

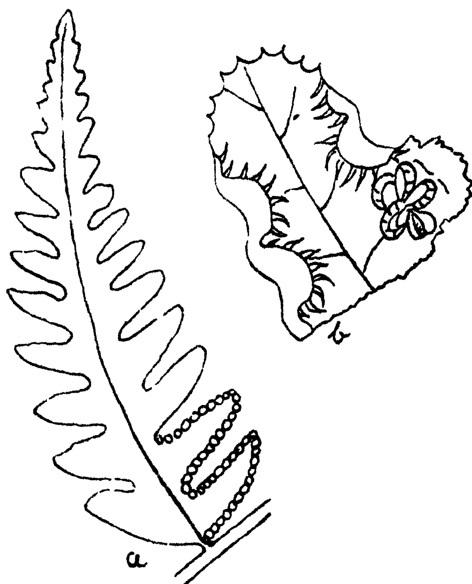
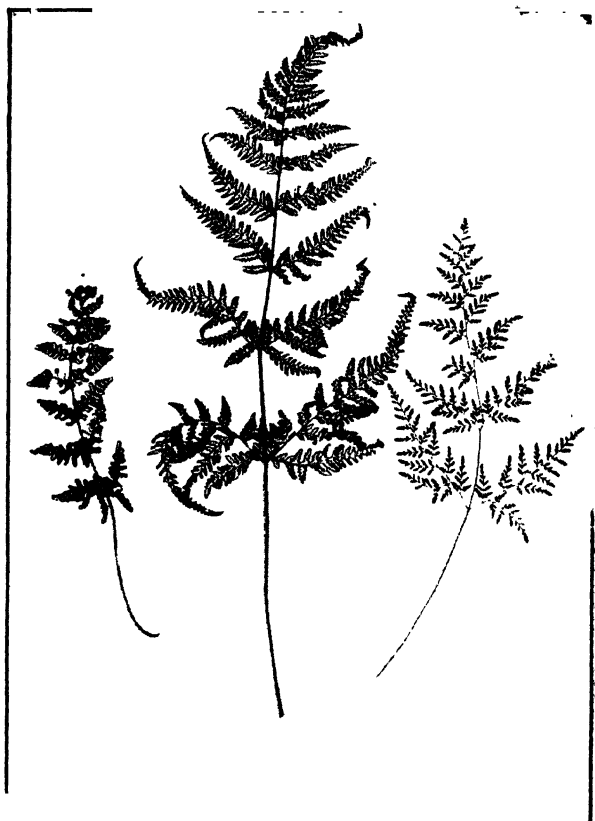


FIG 31.—*Cheilanthes farinosa.*
(*a*) Pinna (nat size). (*b*) Part of segment (× 6)

and up to 8,000 feet on the hills; Ceylon; Burma.—Tropical America; Java; Philippines; East Africa; East African Islands; Arabia.

Var. *chrysophylla* Bedd. has rich yellow powder on the under-surface. It must be

PLATE VI



Cheilanthes albomarginata Clarke. *Cheilanthes tenuifolia* Sw.
Cheilanthes farinosa Kaulf.

To face page 79

noted, however, that the white powder of the typical *farinosa* often turns yellow through age. Such specimens should not be mistaken for *chrysophylla.*

Distribution: Bombay Presidency—Lena Hill (Nasik District), Khandala, Matheran, Igatpuri.—Khasya, 5,000 feet.

2. *Cheilanthes albomarginata* Clarke

Very much like *Cheilanthes farinosa* but distinguished from it by the following characters:—(1) The presence of pale-margined scales on the stipes as well as on the primary and secondary rachises and costæ, (2) the highly lacerate indusia, (3) a dwarfish sturdier habit, and (4) the comparatively small size of the fronds and their outline which is nearer to lanceolate than to triangular. [Plate VI.]

Distribution: Bombay Presidency—Igatpuri, Panchgani, Mahableshwar, Purandhar, Lohagad Hill (Poona District), Matheran, Amboli Hills.

North-west Himalayas; Kashmir, Basaoli 5,000 feet; Dalhousie, 6,000 feet; Simla 7,000 feet; Gurwhal 2,000–9,000 feet.

3. *Cheilanthes tenuifolia* Sw.

Rhizome short, creeping. Stipes purple-black, scaly. Frond ovate or triangular, tri-pinnatifid; pinnules linear-acuminate, segments oblong-lanceolate. Main rachis winged above, partial rachises all narrowly winged. Texture almost membranaceous. Sori circular, eventually confluent.

Distribution: Bombay Presidency—North Kanara, common everywhere during the rains, dying down shortly after, Karwar, Castle Rock; Deccan, dry localities; Londa on claybanks; also seen at one place at Mahableshwar; Goa territory, Margao (near a spring). [Plate VI.]

Madras Presidency, common in the plains and on low hills up to 4,000 feet; Bengal; Assam; Chittagong; Dacca; Chota Nagpur; Khasya up to 3,500 feet; Sikkim; Malay Peninsula.—China; Australia; New Zealand; Polynesia; Uruguay; Malay Islands.

Genus XV.—Pteris L.

(Deriv. Greek name for fern, from Gr. *Pteryx*, a wing—in allusion to the prevalence of pinnate form.)

Indusium quite continuous, sori linear, continuous, occupying a slender filiform receptacle in the axis of the indusium. Veins free, rarely those of the last division but one or more are less connected by arching veins at the very base.

I. Stipes tufted, indusium single.

(*a*) Integrifoliæ.—Lower pinnæ linear, undivided.

1. *P. longifolia.*

(*b*) Furcatæ.—Lower pinnæ forked or slightly pinnate.

(*i*) Pinnæ of the sterile frond considerably broader than the fertile and distinctly toothed.

1. Sterile frond about the size of the fertile. Lower pinnæ cleft down into two or three pinnules.

2. *P. cretica.*

2. Sterile frond much smaller than the fertile and more compound. Lower pinnæ simple, forked, trifid or compound.

3. *P. ensiformis.*

(*ii*) Pinnæ of the sterile frond not much broader than the others, scarcely toothed.

4. *P. pellucida.*

(*c*) Bipinnatæ.—Lowest pinnæ at least bipinnatifid.

(*i*) Pinnæ cut down nearly to the rachis into numerous linear oblong segments.

5. *P. quadriaurita.*

(*ii*) Pinnæ cut down into several narrow linear lobes which widen suddenly on both sides within a short distance of the base.

6. *P. patens.*

(*d*) Tripartitæ.—Lowest pinnæ much longer than the others, often nearly equalling the central portion of the frond.

7. *P. wallichiana.*

II. Stipes distant on a creeping rhizome, indusium double.

8. *P. aquilina.*

1. *Pteris longifolia* L.

Rhizome creeping. Stipes scaly. Fronds broadly lance-shaped in outline, 1–2 feet long, 4–9 inches wide, often narrowed below, pinnate with an odd pinna at the apex; pinnæ numerous on each side, sessile, up to ½-inch broad, gradually tapering from a broad base, entire or minutely crenate. Rachis naked or scaly. Texture membranaceous to leathery. [Fig. 32 and Plate VII.]

Distribution: Bombay Presidency—North Kanara, Pupa, Arbail Ghat,

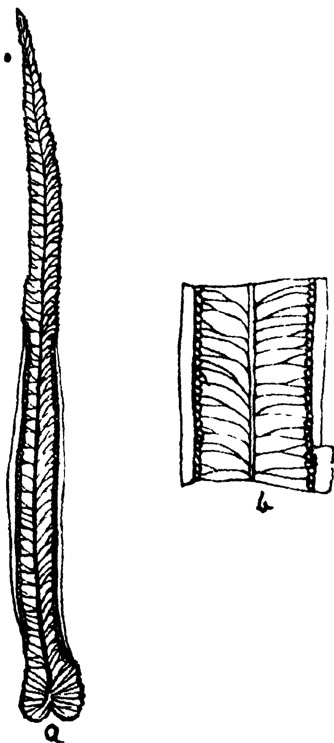


FIG. 32.—*Pteris longifolia* L.
(*a*) Pinna (nat. size).
(*b*) Part of Pinna (× 3).

Anshi, Yan, Castle Rock; Konkan, below Mahableshwar, Bassein; Bombay Island, Mahim, Malabar Hill; Goa territory, Old Goa, Panjim, Mapuca, Marmagoa and along the M. & S. M. Railway in damp places; abundant in the neighbourhood of Dood Sagor.

Madras Presidency; Bengal, in the plains and up to 5,000 feet; Ceylon; Burma. Widely distributed over the whole world.

This fern is commonly grown in gardens. It has run wild at Mahim, where it is very common on the damp walls of wells, likewise on Malabar Hill, where it grows in hedges near the Hanging Gardens. The capacity of the spores to vegetate abundantly upon all moist surfaces and in the crevices of walls probably explains its frequent occurrence outside the limits of cultivation.

Var. *mariesii* (Hort.)—This is a garden variety with shorter fronds and narrower pinnæ. It keeps closer to the pot.

2. *Pteris cretica* L.

Rhizome creeping. Stipe erect, naked, straw-coloured. Frond 6–12 inches long, 4–8 inches broad, pinnate; pinnæ linear, lance-shaped, up to nearly an inch broad, the upper

pinnæ simple and usually sessile with the wings decurrent on the rachis, the lower usually stalked and cleft down to the base into 2–3 pinnules, margin serrate, fertile segments narrower, and serrate where barren. Surfaces naked. Rachis naked. Texture leathery. Veins simple or forked, closely parallel. Sori continuous on the margin. [Plate VII.]

Distribution: Madras Presidency, very common from sea level up to 8,000 feet; Bengal Presidency, very general up to 9,000 feet; Ceylon; Burma.—Africa, Tropical America, South Europe and elsewhere.

A garden fern.

Var. *albolineata* (Hort.)—This is a garden variety having broad white bands down the centre of the pinnæ.

3. *Pteris ensiformis* Burm.

Rhizome short, creeping. Stipe up to 10 inches long, naked. Fronds of two sorts, up to 12 inches long by 3–6 inches broad; fertile fronds with lateral pinnæ either simple, forked, trifid, narrow, pinnules linear, acuminate, more compound, about ¼-inch broad, segments very narrow, ¼-inch broad, almost sessile with lower wing continuous on the rachis. Sterile

fronds generally smaller, more compound with the pinnules, much broader and crenate, serrate at the margins. Surfaces naked. Rachis naked. Texture almost leathery. Veins usually once or twice forked. [Plate VII.]

Distribution: Malabar, rare; hills of Vizagapatam district, common; plains of East Bengal; Bhotan to Chittagong; Ceylon; Burma; Malay Peninsula.—Tropical Australia; China; Polynesia.

Var. *victoria* (Hort.)—This is a garden variety having the fronds variegated with white.

4. *Pteris pellucida* Presl.

Stipes naked. Fronds 12–18 inches long, egg-shaped to lance-shaped, pinnate; pinnæ few, usually sessile, lance-shaped up to about 1-inch broad, all simple or the lowest pair forked, margin when barren, entire wavy, crisped or finely crenate. Surfaces bright, green, glossy, naked. Rachis naked. Texture leathery. The frond often consists of one pinna only. [Fig. 33 and Plate VII.]

Distribution: Bombay Presidency—North Kanara, very common everywhere, Anmod, Pupa, Karwar, Guddhali, Anshi, Nilkund Ghat,

Jog Forest, Castle Rock; Mahableshwar; Savantwadi, Vetora; Salsette Island, above Kaneri caves, 1,500 feet high; Matheran.

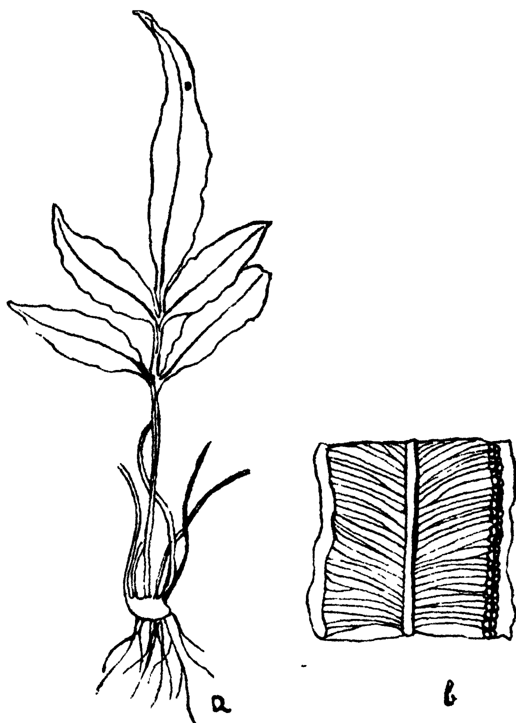


FIG. 33 —*Pteris pellucida* Presl.
(*a*) Complete plant ($\times \frac{1}{4}$). (*b*) Part of pinna (nat. size).

Western forests of Madras Presidency; plains and hills of Bengal up to 3,000 feet

elevation; Burma.—Malay Islands; Guinea Coast.

A variety with broad white bands down the centre of the pinnæ occurs on the Anshi and Nilkund Ghats and in the Jog Forest.

5. *Pteris quadriaurita* Retz.

Caudex short, erect. Stipes naked or rough, varying much in size Fronds lanceolate or ovate; pinnate pinnæ cut down nearly to the rachis into numerous linear-oblong segments, the lowest pair or several lower pairs usually again compound with similar but smaller pinnæ arising from the lower side of the base. Texture membranaceous to almost leathery. The costæ are armed with bristles above. Veinlet usually once forked and free (Forma *quadriaurita* Type) or the lowest ones of two adjoining veins unite in pairs into an arch (Forma *biaurita*) or both these kinds of venation occur in one and the same frond. (Forma *nemoralis*.)

The above is an expanded description intended to embrace the three species, *Pteris quadriaurita* Retz., *Pteris* (Campteria) *biaurita* L. and *Pteris* (Campteria) *nemoralis* Willd., which we consider simply as forms of one and

PLATE VII

Pteris quadriaurita Retz. var *setigera* Bedd

Pteris pellucida Presl.

P

Pteris longifolia L



the same species based on venation which is not constant, specimens of obvious *biaurita* lapsing into *nemoralis* by some of the basal veins missing connection, whilst those which would ordinarily be taken for *quadriaurita* having some arched veins.

Distribution: Bombay Presidency—Forma *quadriaurita*,—North Kanara, Tinai Ghat, Castle Rock; Konkan, Matheran, Amboli Ghat, Vetora (Savantwadi State); Panchgani; Mahableshwar; Khandala.

Forma *nemoralis*.—Amboli Hills, Castle Rock, Mahableshwar

Forma *biaurita*.—North Kanara—Jog Supa, Jugelput, Anmode, Kumbarwada, Anshi, Idagoonji; Mahableshwar; Panchgani; Khandala—throughout India, Ceylon; Malay Peninsula.—All round the world throughout the tropics and a little beyond them.

This fern is also grown in gardens.

Var. *setigera* Bedd.—Texture papery, colour brown when dry, segments narrower than in the type, copious stiff hairs on the rachis and costæ, veins all free (as in Forma *quadriaurita*).

A very distinct looking plant. [Plate VII.]

Distribution: Bombay Presidency—North Kanara; Mahableshwar; Dajipur above the

Fonda Ghat; Ambowne; Matheran—Coorg and Malabar.

Var. *argentea* Bedd. has broad white bands down the centre of the pinnæ. We have seen this fern in the Victoria Gardens. In horticulture it is known as *Pteris quadriaurita* var. *argyrea*.

Distribution: Nilgiris and western mountains of the Madras Presidency only at high latitudes; much in cultivation in England.

6. *Pteris patens* H. K

Caudex erect. Stipes stout, scaly at the base. Fronds pinnate with a terminal pinna,

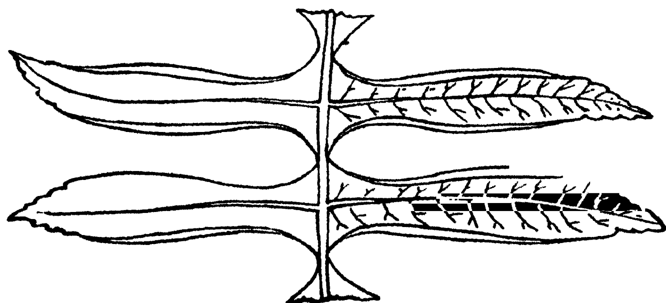


FIG. 34.—*Pteris patens* H. K.
Portion of pinna (× 1½).

6–9 inches long, 1½–2 inches broad and several lateral ones, pinnæ cut down into several

narrow linear lobes which widen suddenly on both sides within a short distance of the base, lobes serrate where sterile, lower pinnæ often divided two or three times. Surfaces naked. Texture almost leathery. Veins usually once forked. [Fig. 34.]

This fern is rarely found in cultivation in the Presidency.

Distribution: Madras Presidency—Carcoor Ghat, Wynaad and Travancore hills, 2,000–5,000 feet; Ceylon, Dodawilla, Matele and Mooroowa forests above 2,000 feet elevation—Borneo, Philippines and Society Islands.

7. *Pteris wallichiana* Ag.

Stipe 5–6 feet long, strong, bright, chestnut brown, naked, glossy. Frond divided into three parts, the lateral ones again forked; the central one often 2 feet long, 1 foot broad, pinnate; pinnules sessile, 4–6 inches long, linear-lanceolate, acuminate, deeply pinnatifid; segments about ½-inch long, linear lance-shaped, blunt at the apex, finely serrate when sterile. Surfaces naked. Rachis like the stipe. Texture herbaceous. Basal veins uniting in pairs into an arch, the rest free. The arching of the veins is

not constant. Sori continuous along nearly the whole length of the edge.

This fern was growing in Mr. W. S. Millard's Fernery on Malabar Hill in 1918. How it came to be there Mr. Millard was at a loss to explain. He had certainly not cultivated it. Possibly some spores finding his fernery a congenial place for their development germinated there giving rise to a stately plant. The frond sent to the St. Xavier's College Museum for examination had a stipe 5–6 feet long and was 4–5 feet each way. There are several goodly specimens of this fern in the Victoria Gardens.

Distribution: Abundant on the Himalayas from Chumba to Bhotan, 3,000–8,000 feet; Khasya—Philippines, Java and Samoa.

8. *Pteris aquilina* L.

Rhizome stout, creeping extensively beneath the surface of the ground. Stipes erect, naked, arising at intervals from the rhizome, dark-coloured at the lower extremity which is covered by the soil. Frond decompound, almost triangular in form, apex pinnate, below it are ovate pinnæ which become gradually more and more divided downwards until the lowest ones are pinnate with lanceolate pinnules cut down

into numerous lanceolate segments; ultimate segments up to about an inch long and $\frac{1}{6}$-inch broad. Surfaces and rachis naked or hairy. Texture thin or almost leathery. [Fig. 35 and Plate VII.]

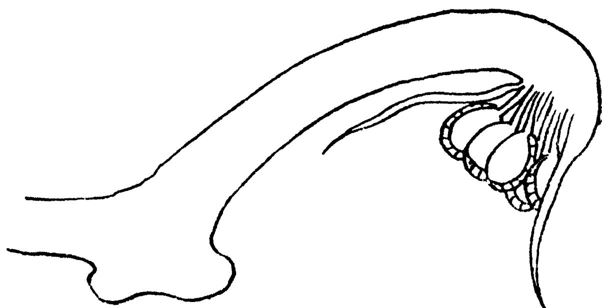


FIG. 35.—*Pteris aquilina* L.
Vertical section through segment showing the double indusium.

This is the common Brake or Bracken. It grows up to seven feet high. Used as packing material.

Distribution: Bombay Presidency—North Kanara, common on the crest of the ghats in dry places, Castle Rock; Mahableshwar; Panchgani; Sakar-Pathar (Lonavli); Khandala; Konkan—Matheran, Amboli Hills; Kanor (Belgaum District).

Throughout India, Ceylon and the Malay Peninsula on the mountains 2,000–8,000 feet.

Throughout the whole world except the Arctic Zone and temperate South America.

Genus XVI.—Doryopteris J. Smith

(Deriv. *Dory*, spear; *pteris*, fern—in allusion to the shape of the fronds.)

Fronds triangular or halberd-shaped or palmately divided; veins copiously anastomosing, without free included veinlets. The rest as in Pteris.

Doryopteris ludens Bedd. (*Pteris ludens* Wall.)

Rhizome creeping, scaly; scales closely adherent to the rhizome and having white margins. Stipe arising at intervals from the rhizome, black polished, slightly scaly, often hairy, those of the barren frond 3–4 inches long, those of the fertile up to 12 inches long. Fronds of two kinds. Barren ones triangular to halberd-shaped with two well-marked lobes, margin entire. Fertile fronds 4–6 inches each way, deeply lobed and roughly palmate, the lobes lanceolate and five in number, two basal, two spreading and one terminal. The basal lobes are deflexed and often forked. Texture leathery. Midribs of the segments polished like the

stipe. Veins anastomosing, hidden. Sori continuous all round.

Grown in gardens.

Distribution: Chittagong Hills up to 1,000 feet elevation; Orissa on the Balasore Hills; Burma; Malay Peninsula.—Philippine Islands.

GENUS XVII.—LITHOBROCHIA PRESL.

(Deriv. *Lithos*, stone; *brocha*, spots—from the areoles of the veins resembling pavement.)

Veins copiously anastomosing with free included veinlets. The rest as in Pteris.

Lithobrochia tripartita J. Sm.

Stipe erect, straw-coloured or brownish, naked, polished. Fronds divided into three parts; the central division, the longest, having a terminal pinna 6–9 inches long and several lateral pinnæ; pinnæ cut down almost to the rachis into linear-oblong segments which are slightly toothed when barren; lateral divisions smaller than the central and similar to it; sometimes forked again. Surfaces and rachis naked. Texture herbaceous. Veins fine, anastomosing, forming chiefly two series of areoles (parallel with the midrib) from which proceed free veinlets which fall short of the margin and terminate

in thickened ends. Sori continuous on the lower two-thirds of the segments.

Cultivated.

Distribution: Ceylon—common about Galle and the Central Provinces; Madras Presidency much cultivated, and said to be found wild in the Cochin forests.; Malacca.—West Tropical Africa; East African Islands; Queensland; the Philippines; Polynesia.

GENUS XVIII.—CERATOPTERIS BRONG.

(Deriv. Gr. *Keras*, *Keratos*, a horn; *pteris*, a fern. The horned fern—in allusion to the stag-horn looking fronds.)

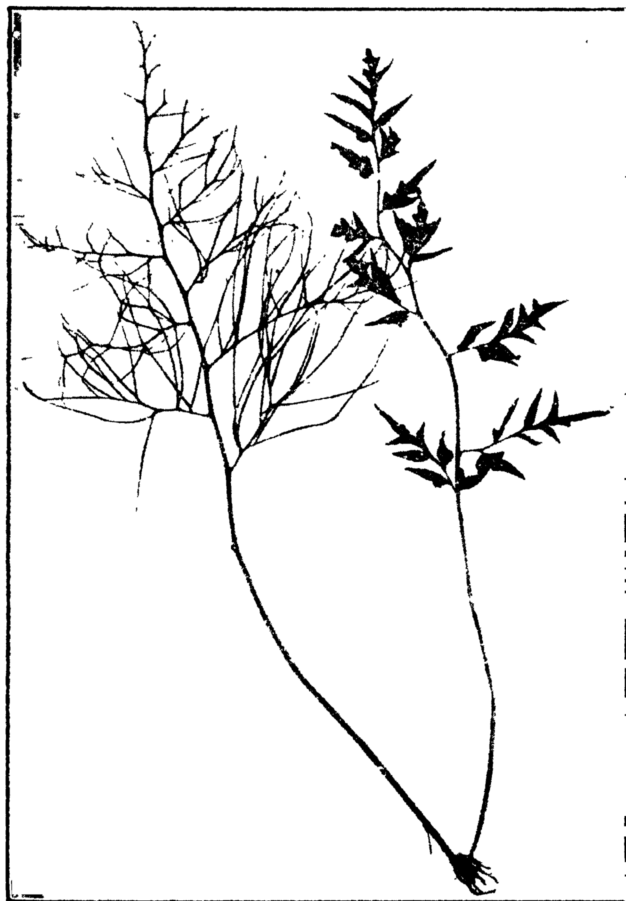
A true water. fern. Fronds fragile; fertile fronds decompound with the segments forked and pod-shaped. Sori linear, marginal, almost parallel. Veins of sterile frond transversely elongated and distantly anastomosing.

A very anomalous genus.

Ceratopteris thalictroides Brong.

A water plant growing in stagnant pools, tanks and marshes. Stipes somewhat quadrangular, thick, inflated, filled with air spaces. Fronds of two kinds. Barren ones, simple or slightly divided or 2–3 pinnate. Fertile ones

PLATE VIII



Ceratopteris thalictroides Brong.

To face page 97

2–3 pinnate, segments forked, pod-like. The fronds often bear buds which fall off and form new plants. [Plate VIII.]

Distribution: Bombay Presidency—Common in tanks and streams, in swampy ground, and even in rice-fields in the rains; North Kanara, Karwar, Yellapur; Londa; Goa Territory. Panjim; Salsette Islands, Vehar Lake, Vehar Stream, Condita in tank; Bombay Island, Matunga, in swampy ground; Bassein, Nirmal tank.

Throughout India, Ceylon and the Malay Peninsula up to 3,000 feet elevation.—In the tropics of the whole world.

TRIBE VII.—BLECHNEÆ

Sori linear, oblong, parallel with the midrib and margin, nearer the midrib; indusium linear, opening towards the midrib.

GENUS XIX.—BLECHNUM L.

(Deriv. One of the Greek names for fern.)

Sori linear, mostly continuous, parallel to and quite close to the midrib; veins free.

(*a*) Lower pinnæ reduced to mere auricles.

1. *B. orientale.*

(*b*) Lower pinnæ not reduced to mere auricles.

(*i*) Greater portion of the frond pinnate.

2. *B. occidentale.*

(*ii*) Frond pinnate only at the very base.

3. *B. cartilagineum.*

1. *Blechnum orientale* L.

Caudex stout, erect, scaly. Stipes 4–8 inches long, scaly below; fronds 1–3 feet long, 6–12 inches broad, lance-shaped, ovate in outline, pinnate; the pinnæ 4–8 inches long, $\frac{3}{8}$–$\frac{3}{4}$ inch broad, alternate, adherent, entire, linear, sessile, tapering from a broad unequal base to a fine point; the upper pinnæ decurrent; some of the lowest reduced to mere auricles. Surfaces naked. Texture leathery. Veins fine and close, nearly parallel. [Fig. 36.]

We have grown this fern in a fernery and found that it thrives well when the pot is saturated with water.

Distribution: Bombay Presidency—North Kanara, very common—Tinai Ghat, Devimunni Ghat, 1,300 feet, Katgal, Castle Rock; Mahableshwar; Konkan, Amboli Hills (foot of

Ram Ghat and also by the sides of rivulets), Vetora (Savantwadi) in marshy places; Goa territory, common all along the railway line from Collem to Dood Sagor.

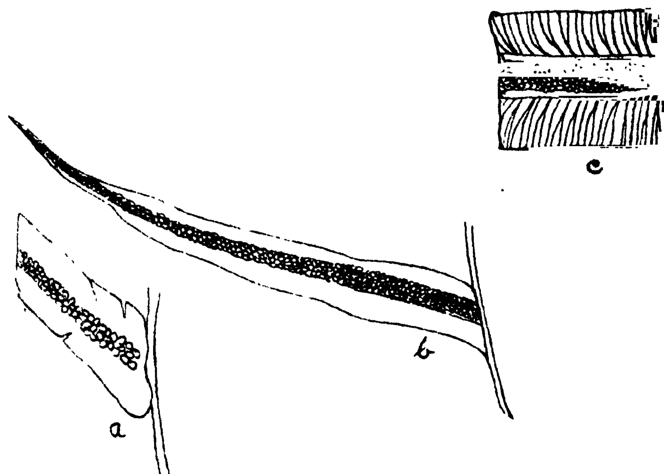


FIG. 36—*Blechnum orientale* L.
(*a*) and (*b*) Pinnæ (nat. size). (*b*) Portion of pinna (× 2).

Throughout India, Ceylon and the Malay Peninsula.—Malay Islands; China; Polynesia; Australia.

2. *Blechnum occidentale* L.

Caudex stout, erect, clothed at the crown with lance-shaped long pointed scales. Stipes

6–12 inches long, erect, scaly. Fronds pinnate, lance-shaped, acuminate, 9–18 inches long, 4–8 inches broad, pinnæ 3–6 inches long, $\frac{3}{8}$–$\frac{3}{4}$ inch broad, narrowed gradually to a point from a broad cordate or even auricled base. Rachis and both surfaces naked or slightly hairy. Texture leathery. Veins inconspicuous.

Cultivated.

Distribution: America, common from Mexico and West Indies southward to Chili and South Brazil.

3. *Blechnum cartilagineum* Sw.

Caudex oblique, densely clothed at the crown with blackish fibrillose scales. Stipes 4–6 inches long, scaly and covered with short, hard tubercular excrescences. Fronds 1–2 feet long, 6–9 inches broad, pinnate, broadly lance-shaped; pinnæ sessile, dilated and connected at the base, narrowed gradually towards the point; margin finely toothed. Rachis and both surfaces naked. Texture leathery. Veins fine. Sori in a broad line close to the midrib.

Cultivated.

Distribution: Temperate Australia.

TRIBE VIII.—ASPLENIEÆ

Indusium linear or oblong or horseshoe-shaped, sometimes double; sori attached to the veins.

GENUS XX.—THAMNOPTERIS PRESL.

(Deriv. *Thamnos*, a thicket; *pteris*, a fern.)

Sori linear; veins forked, more or less parallel, connected just within the margin by a transverse vein. (This connection is not quite constant.) Fronds simple.

Thamnopteris nidus Presl.

Rhizome erect. Stipes short, scaly. Fronds up to 6 feet long and 6 inches broad, linear-lanceolate, margin entire. The fronds are arranged symmetrically on a crown forming a circular, deep, vase-shaped hollow. Sori along the veins, not reaching the margin. [Fig. 37-*a*.]

Cultivated. Known in gardens as *Asplenium nidus*, *Asplenium nidus-avis*, and Bird's Nest Fern.

The fern occurring wild in the Presidency is what would come nearest to Beddome's variety *phyllitidis*, but this, we think, is merely a size-form of the species.

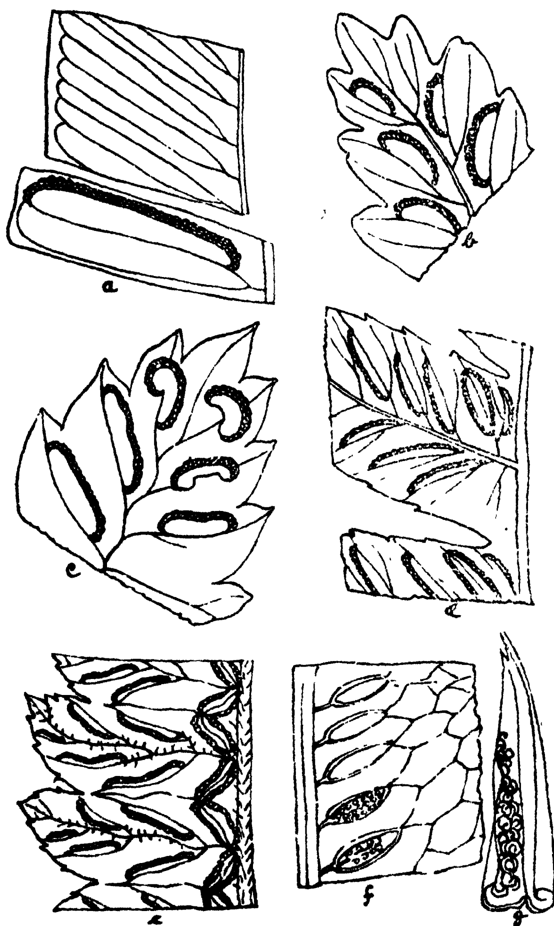


FIG 37.—(*a*) *Thamnopteris nidus* Presl Portion of frond (about nat size).
(*b*) *Asplenium lunulatum* Sw. Portion of pinna (× 2⅘).

(c) *Athyrium hohenackerianum* Bedd. Portion of segment (much magnified).

(d) *Diplazium latifolium* Moore. Portion of segment (× 5¾)

(e) *Anisogonium esculentum* Presl. Portion of pinna (× 3⅛)

(f) *Allantodia javanica* Bedd Portion of pinna (magnified).

(g) *Actiniopteris dichotoma* Bedd Portion of segment (magnified)

Distribution: Bombay Presidency—North Kanara, Jog, Kansar, Nilkund, Tyagli, Sirsi to Sidhapur. Growing on trees.

Western forests of the Madras Presidency, very common; North India, Himalayas, Khasya; Malay Peninsula.—Java; Luzon; Samar; the Philippines; Tropical Asia; Mauritius; Madagascar, etc.

GENUS XXI.—ASPLENIUM L.

(Deriv. *A*, primitive; *splen*, spleen—in allusion to its medical properties)

Sori linear or oblong, single, veins free.

I. Fronds once pinnate.

(*a*) Pinnæ narrowed suddenly on the upperside, the inner edge nearly parallel with the main rachis, the lower side obliquely truncate.

(*i*) Texture of frond herbaceous, colour dark-green, the veins clearly visible.

1. *A. lunulatum.*

(*ii*) Texture of frond leathery or almost leathery, colour pale-green, veins comparatively obscure.

1 Pinnæ more or less lanceolate, often caudate.

2. *A. falcatum.*

2. Pinnæ rather linear-oblong or half-ovate.

3. *A. laciniatum.*

(*b*) Pinnæ with from half to whole of the lower side cut away.

4. *A. unilaterale.*

II. Fronds 2–4 pinnate, ultimate divisions linear.

(*a*) Fronds dimorphous.

5. *A. dimorphum.*

(*b*) Fronds not dimorphous.

(*i*) Frond 6–8 inches broad, segment distant.

6. *A. viviparum.*

(*ii*) Frond 2–3 inches broad, segments close.

7. *A. belangeri.*

1. *Asplenium lunulatum* Sw.

Rhizome short, erect or obliquely ascending. Stipes tufted, nearly naked, grey or black polished. Fronds 8–18 inches long, 1½–3 inches broad, lance-shaped, pinnate; pinnæ ¼–½ inch broad, crenate, unequal-sided, the upper side suddenly narrowed at about a right angle, the lower obliquely cut off; lower pinnæ often deflexed. Veins simple or once-forked. Sori not reaching the margin or midrib [Fig. 37-*b* and Plate IX.]

Distribution: Bombay Presidency—North Kanara, Nilkund.

South India: Nilgiris, Anamallays.

Var. *trapeziforme* Bedd. Pinnæ 15–20 pair, the lowest the largest, 1½-inch long.

Distribution: Bombay Presidency—Mahableshwar, Panchgani in caves behind the Tableland.

South India: Nilgiris, Anamallays.

2. *Asplenium falcatum* Lam.

Rhizome scaly, slightly creeping. Stipes tufted, glabrous or more or less scaly. Fronds

up to three feet long, pinnate ; pinnæ lanceolate, often caudate, with the base often much auricled ; edges serrated, or lobed with the lobes serrate ; the two sides unequal, the lower obliquely truncate at the base.. Texture leathery. Rachis glabrous or covered with hair-pointed scales. Sori in long irregular lines reaching nearly to the margin. [Plate IX.]

Distribution : Bombay Presidency—North Kanara, Yekambi; Savantwadi; Mahableshwar.

Madras Presidency, western mountains; Ceylon; Malay Peninsula; Soonderbun; Koolna in Jessore.—Australia; South Africa and its islands; Polynesia.

Asplenium crinicaule Hance and *Asplenium macrophyllum* Swartz being doubtfully distinct from *Asplenium falcatum* are placed here as varieties of the species.

Var. *crinicaule*. Stipes and rachises densely covered with hair-pointed scales.

Distribution: Bombay Presidency—North Kanara.

Madras Presidency on the Anamallays and in Coorg, 3,000–4,000 feet; Sikkim, Jaintia Hills, 4,000–5,000 feet.—China.

Var. *macrophyllum*. Pinnæ generally larger and broader and less cut than those of the type.

Distribution: Bombay Presidency—North Kanara.

Madras Presidency, western mountains; Ceylon; Malay Peninsula.—Australia; South Africa and its islands; Polynesia.

4. *Asplenium unilaterale* Lam.

Stipes scattered, naked, dark-brown, polished or grey. Fronds 6–15 inches long, pinnate; pinnæ 1–3 inches long, ¼–1 inch broad, unequal sided, two-thirds of the lower half being entirely cut away, the upper half of the base narrowed at a right angle; margin incised except at the portion where it has been cut off. Texture thinly herbaceous.

Though the type is not found in the Presidency, the following varieties occur:—

Var. *rivale* Bedd. Pinnæ close set, smaller than in type, in shape almost a parallelogram; sori confined to the apex

Distribution: Bombay Presidency—North Kanara, Nilkund, Yan, Malimani.—Pulney Hills and Anamallays, only in river-beds.

Var. *udum* Atkinson? Pinnæ transparent, membranaceous, smaller than in the type, very oblique and the cutting often fimbriate (i.e., fringed).

Distribution: Bombay Presidency—North Kanara, Anmode, Cooesi.

Himalayas, Dalhousie, 5,500 feet and other localities, pendent from dripping rocks.

3. *Asplenium laciniatum* Don.

Stipe scaly. Frond up to two feet long, pinnate; pinnæ linear, oblong or half-ovate, very much cut away and unequal at the base, slightly pinnatifid with segments serrated, or deeply pinnatifid with segments distant. Texture almost leathery. Rachis scaly. [Plate IX.]

The fronds roll up after the rains and so resist the dry season. When dry the fronds can be artificially uncurled in water.

Distribution: Bombay Presidency—North Kanara, Anshi, Yekambi; Panchgani; Mahableshwar; Matheran, on trees; Lonavla.

Madras Presidency, all the western mountains, 3,000–8,000 feet; Himalayas, Gurwhal to Bhotan; Khasya; Ceylon.—Japan.

5. *Asplenium dimorphum* Kze.

Stipe 6–12 inches long, naked. Fronds 2–3 feet long, 12–15 inches broad, ovate-triangular; of two kinds; sterile frond as a rule bipinnate with roundish oval pinnules which are wedge-

PLATE IX

Asplenium lunulatum Sw.

Asplenium laciniatum Don. *Asplenium falcatum* Lam.



Athyrium felix-foemina Roth.

Athyrium hohenackerianum Bedd. *Athyrium falcatum* Bedd.

shaped at the base and serrated at the margin; fertile frond almost three-pinnate with the secondary pinnæ cut down to a winged rachis into very narrow simple or forked linear pinnules or segments; sometimes fertile and sterile pinnæ on the same frond. Texture herbaceous. Sori linear, one to each segment.

Cultivated.

Distribution: Norfolk Island.

6. *Asplenium viviparum* Presl.

Stipe 6–9 inches long, firm, erect, greenish, covered with deciduous hair-pointed scales. Frond 1–2 feet long, 6–8 inches broad; pinnæ 4–6 inches long, 1½–2 inches broad, cut down to a compressed rachis into numerous pinnatifid pinnules; ultimate segments narrow, linear, often forked. Pinnæ proliferous.

Cultivated. The garden synonym for this fern is *Asplenium bulbiferum* (Hort.).

Distribution: Mauritius and Bourbon.

7. *Asplenium belangeri* Kze.

Caudex short, stout, erect. Stipe 4–8 inches long, erect, greenish. Fronds 1–2 feet long, 2–3 inches broad, bearing on each side numerous horizontal pinnæ, which are cut down

throughout to a broad winged rachis into blunt linear pinnules, the lowest of which are often forked. Texture leathery. Veins one to each segment. Sori one to each segment. The fronds are proliferous bearing bulbils in the axils of many of the pinnæ.

Cultivated.

Distribution : Malay Peninsula.—Java ; Sumatra ; Borneo.

Genus XXII.—Athyrium Roth.

(Deriv. unknown.)

Veins free, sori more or less curved, sometimes horseshoe-shaped.

I. Frond less than five feet long.

(*a*) Indusium bullate (i.e. puckered).

1. *A. hohenackerianum.*

(*b*) Indusium not bullate.

(*i*) Sori large, some at least reniform.

2. *A. macrocarpum.*

(*ii*) Sori never reniform.

1. Fronds one-pinnate, segments crenate.

3. *A. falcatum.*

2. Fronds 2–3 pinnate, segments with strong sharp serratures.

4. *A. felix fœmina.*

II. Fronds 5–6 feet long.

5. *A. gymnogrammoides.*

1. *Athyrium hohenackerianum* Bedd.

Rhizome short, densely covered with scales. Stipes tufted, scaly throughout. Fronds 6–18 inches long, 1½–3 inches broad, lanceolate or ovate-lanceolate, pinnate or almost bipinnate with pinnatifid apex; pinnæ 1–2¾ inches long, cut down nearly or quite to the rachis into ovate or oblong serrated segments. Texture herbaceous. Surfaces naked. Rachis scaly below. Indusium curved or horseshoe-shaped, bullate (i.e., puckered). [Plate IX.]

The limits of this species and of *Athyrium felix fœmina* have not been clearly defined by authors. Indeed, small specimens of the latter fern are often mistaken for this species. The chief difference between the two seems to lie in the involucre which in *Athyrium hohenackerianum*, according to Hooker, in his 'Species Filicum,' is 'singularly bullate, afterwards

appearing to burst irregularly and to be reflexed, often giving the appearance of such an involucre as Brown describes to his genus *Allantodia*, but it is not so in reality.'

The strong and sharp serratures of *Athyrium felix fœmina* may well be relied upon in distinguishing that species, when the involucres have been wiped off, as often happens in herbarium specimens. [Fig. 37-*c*.]

Distribution: Bombay Presidency—North Kanara, common during the rains; Karjat; Khandala; Igatpuri, Igatpuri Ghats; Matheran; Vetora (Savantwadi); Bombay Island, Sion Wood; Salsette Island, near Tulsi Lake, Keneri Caves, Borivli; Sind.

Madras Presidency in the western forests, from the plains up to 4,000 feet; Ceylon.

2. *Athyrium macrocarpum* Bedd.

Stipes scaly below. Fronds up to three feet long, lanceolate, pinnate with pinnæ pinnatifid or bipinnate with pinnules deeply pinnatifid. Texture herbaceous. Sori very large, reniform, (as in Lastrea), rachis naked, linear or horseshoe-shaped. Indusium fimbriate (i.e., fringed) at the margin.

Distribution: Bombay Presidency—North Kanara.

South India, very common on the western mountains, above 3,000 feet; Ceylon; Himalayas, Gurwhal to Bhotan, 2,000–9,000 feet; Khasya; Burma; Malay Peninsula.—Malay Islands; China; Japan.

3. *Athyrium falcatum* Bedd.

We have examined several specimens of Athyrium, which we are not able to place. They answer well Beddome's description of *Athyrium falcatum* which we quote.

Stipes 1–9 inches long with many linear golden scales at the base; fronds 6–14 inches long, with the rachis above dilated or winged, linear-lanceolate, narrowed at both ends, pinnæ 15–20 on each side, sessile, alternate, 1–1½ inches long, by ¼–⅓ inch broad, falcate-ovate, deflexed, obtuse or acuminate, generally with a large obtuse auricle at both the superior and inferior base, above pinnatifid almost half down to the costa; segments obtuse, crenated, sori numerous on each side of the costa, at length confluent and covering the whole or nearly the whole of the under surface. [Plate IX.]

8

Distribution: Bombay Presidency—Khandala, Lonavla, Purandhar, Panchgani on the way to the Tableland, Mahableshwar, Matheran, Igatpuri.

South India, Anamallay Hills, dry grassy places, 5,000 feet; Myhenda Hill near Berhampore, 4,500 feet; Parasnath, 4,000 feet.

4. *Athyrium felix fœmina* Roth.

Caudex ascending, scaly. Stipes tufted, straw-coloured, scaly. Fronds 1–4 feet long, lanceolate, 2–3 pinnate; lower pinnules of pinnæ deeply pinnatifid into ovate segments having a few sharp serratures; superior ones more entire, coarsely serrated, uppermost ones confluent into a pinnatifid, or serrated long point. Texture thinly herbaceous. Rachis naked. Involucres in two rows on the secondary pinnæ, short, oblong. [Plate IX.]

Two varieties, viz. *pectinata* and *flabellulata*, have been mentioned by Birdwood as occurring in the Presidency. We have not been able to distinguish these in the material at our disposal. The specimens we have examined came from Panchgani—north side of Tableland, Matheran, Khandala, and North Kanara.

Below is a description of the two varieties given by Beddome in his Handbook.

Var. *pectinata* Wall? Very finely cut, tri-pinnate, four-pinnatifid, bright-green; rachis slender, but scarcely succumbent or grooved when dry; involucre sub-quadrate, or short oblong, little horseshoe-shaped, sub-persistent.

Distribution: Bombay Presidency—Mahableshwar; Sind.

Himalayas, Sikkim to Gurwhal, 2,000–5,000 feet; Parasnath, 4,000–5,000 feet; mountains of the Godavari and Central India; Mount Abu.

Var. *flabellulata* Clarke. Two-pinnate; rachis firm, round when dry, fronds red, 1–3 feet; secondary pinnæ deeply pinnatifid; segments laciniate, i.e. deeply cut, involucre small, fugaceous; sori scattered, round.

Distribution: Bombay Presidency—Mahableshwar.—Sikkim, 13,000 feet, Yakla; Jongri.

5. *Athyrium gymnogrammoides* Bedd.

Fronds large, 5–6 feet long, 2–3 pinnate; pinnæ 12–16 inches long, secondary pinnæ up to 4½ inches long, 1½-inch broad; either deeply cut almost to the winged rachis, or pinnate, the wing being absent. Ultimate segments oblong,

lobed one-third of the way down; sori near the midrib.

Distribution: Bombay Presidency—Mahableshwar.—Ceylon, Central Provinces, 5,000–6,000 feet.

GENUS XXIII.—DIPLAZIUM SWARTZ

(Deriv. *Diplazo*, I double—in allusion to the double indusia.)

Veins free, some of the sori double, that is, on each side of the vein, others single as in Asplenium.

(*a*) Caudex not arborescent. Frond simply pinnate.

1. *D. sylvaticum*.

(*b*) Caudex often arborescent. Frond bipinnate.

(*i*) Stipes and all the rachises prickly and scaly. Veinlets 8–12 to a segment. Sori reaching the midrib but not the margin.

2. *D. asperum*.

(*ii*) Stipes simply scaly, rachises naked. Veinlets fewer, about six in number.

Sori reaching both midrib and margin.

3. *D. latifolium.*

1. *Diplazium sylvaticum*

Caudex somewhat erect. Stipe scaly. Frond 1–3 feet long, 4–8 inches broad, ovate-lanceolate and simply pinnate ; pinnæ about six inches long, one inch broad, tapering to a fine point from a broad base ; margin entire or broadly lobed or slightly waved or serrated. Rachis and surfaces naked. Texture thin, herbaceous. Veins pinnated in the lobes. Sori in long slender lines.

Cultivated.

Distribution : Madras Presidency, throughout the western forests up to 4,500 feet ; Ceylon, Central Provinces ; Malay Peninsula.—Mauritius ; Fernando Po ; Borneo.

2. *Diplazium asperum* Metten and Blume

Caudex often arborescent. Stipes and all the rachises prickly and scaly. Fronds large, two-pinnate ; pinnules cut down nearly to the rachis into obtuse, crenate or serrate segments. Texture rather leathery. Veins 8–12 to a segment, simple or forked. Sori reaching the

midrib but not the margin, only the lower ones double. [Fig. 38.]



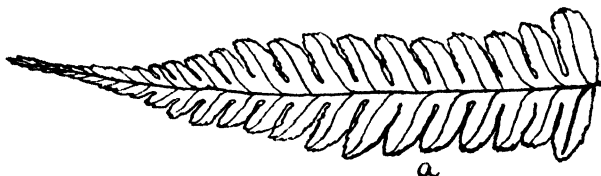


FIG. 38.—*Diplazium asperum* Metten and Blume
(*a*) Pinnule (nat. size). (*b*) Segment (× 4).

Distribution: Bombay Presidency—North Kanara, Supa, Sirsi, Tyagli, Jog.

Madras Presidency, throughout the western forests, from no elevation up to 3,000 feet; Cuddapah forests; Sikkim, banks of the Teesta. —Java.

3. *Diplazium latifolium* Moore

Caudex quite a trunk. Stipes scaly. Fronds large, two-pinnate; pinnules less deeply cut than

in *D. asperum.* Veinlets fewer than in *D. asperum*, about six in number. Sori reaching both midrib and margin. [Fig. 37-*d* and Fig. 39.]

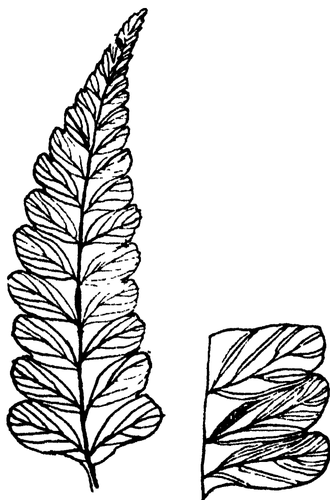


FIG 39.—*Diplazium latifolium* Moore.
Pinnules (nat. size).

Distribution : Bombay Presidency—North Kanara, Tyagli, Hoolgeri.

Madras Presidency, in all the western forests ; North India, throughout the Himalayas and Khasya Hills ; Ceylon ; Malay Peninsula.—Australia ; China ; the Philippines.

GENUS XXIV.—ANISOGONIUM PRESL.

(Deriv. Gr. *Anisos*, unequal; *gonia*, an angle; referring to the angles of the venation.)

Veins anastomosing; sori as in Diplazium.

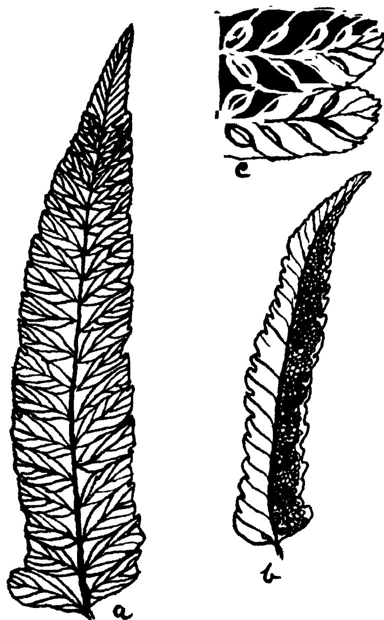


FIG. 40.—*Anisogonium esculentum* Presl.
(*a*) and (*b*) Pinnules (about nat size). (*c*) Portion of pinnule (× 2).

Anisogonium esculentum Presl.

Caudex sub-arborescent, erect. Stipes 1–2 feet long, strong, erect, tufted. Frond 4–6

feet long, as a rule bipinnate, sometimes simply pinnate; pinnules lanceolate, 3–6 inches long, $\frac{3}{4}$–1 inch broad, apex acuminate, base suddenly narrowing, often auricled, margin more or less deeply lobed. Surfaces naked. Rachis often hairy. The main vein of each lobe gives off on each side 6–10 veinlets which tend to unite towards the margin with each other as well as with the veinlets of the next lobe. Sori single or double on the veinlets. [Fig. 37-*c* and Fig. 40.]

Distribution: Bombay Presidency—North Kanara, Jog, Kygaghat, Barch, Idagoonji, Supa, Chandwàdi, Anmode, Cooesi, Devimunni, Sumkund, Tyagli, Kadra, Katgal, growing on the banks of streams, Castle Rock, on the banks of Duski River; Mahableshwar.

South India, common in the plains on the western side and up to 3,000 feet; Bengal plains; Ceylon; Malay Peninsula.—China; Formosa; Malay Islands. Also cultivated.

GENUS XXV.—ALLANTODIA WALL.

(Deriv. *Allantos*, a sausage—in allusion to the form of the indusium.)

Veins anastomosing; areoles elongated near the midrib, smaller towards the margin, with

free marginal clavate veinlets. Sori linear-oblong. Indusium sausage-shaped, quite covering the sorus and bursting irregularly down the centre.

Allantodia javanica Bedd.

Fronds up to 2 feet long, 1 foot broad, pinnate; pinnæ 4–8 inches long, 1–1¾ inches broad, unequal at base to a fine acumination. Veins anastomosing, forming elongated areoles on either side of the midrib and smaller ones near the margin. Sori sausage-shaped, bursting irregularly down the centre. [Fig. 37-*f*.]

Distribution: Bombay Presidency—North Kanara, in moist places along the ghats.

Nepal and Bhotan, 4,000–7,000 feet; Khasya, Makir Hills; Ceylon.—Java; Samoa.

GENUS XXVI.—ACTINIOPTERIS LINK

(Deriv. *Actin*, rays; *pteris*, a fern.)

Fronds fan-like, sori placed on each side of the narrow segment of the frond, linear, elongated, opening towards the midrib.

Actiniopteris dichotoma Bedd.

Stipes densely tufted arising from an oblique caudex, scaly. Fronds like the leaves of a miniature palm (Chamærops); segments dichoto-

PLATE X



Actiniopteris dichotoma Bedd.

mously radiating, narrow, linear, those of the fertile frond larger than those of the barren one. Vernacular 'Bhui Tad'. [Fig. 37-*g*. and Plate X.]

Distribution: Bombay Presidency—Kandala Ghat on Mahableshwar road; Katraj Ghat near Poona, Parvati Hills, Patas, Chakan, Talegaon, Purandhar Fort, Shivpur to Nasrapa, Shirgaon Khind (Satara District), Mungrool (Sholapur District), Lena Hill (Nasik District); Lalling, Dhulia (Khandesh), generally on rocks and old walls.

Throughout India, especially the Peninsula below 3,000 feet; Ceylon.—North Africa; Mascareen Islands; Persia; Kabul.

TRIBE IX.—ASPIDIEÆ

Indusium more or less rounded or kidney-shaped (rarely elliptical), attached either by the centre or sinus.

GENUS XXVII.—MESOCHLÆNA R. Br.

(Deriv. *Mesos*, middle; *chlæna*, cloak; middle-cloaked. In reference to the attachment of the indusium.)

Sori elliptical on the tip of a veinlet but within the margin. Indusium attached longitudinally on the centre of the linear receptacle,

free all round the edge. Veins pinnate, the lower pair of veinlets anastomosing. Fronds bipinnatifid.

Mesochlæna polycarpa Bedd.

Caudex erect. Stipes tufted, short, hairy. Fronds 2–3 feet long, 12–18 inches broad, pinnate; pinnæ up to 9 inches long, ½-inch broad, oblong, lanceolate, dwindling down to mere auricles towards the base, cut down deeply into oblong linear lobes. Rachis hairy. Lower surface hairy. [Fig. 41-*a* and *b*.]

The fern has the habit and venation of Nephrodium.

Distribution: Bombay Presidency—North Kanara.—Malay Peninsula.—Malay Islands.

GENUS XXVIII.—POLYSTICHUM ROTH.

(Deriv. Gr. *Poly*, many; *stichos*, order.)

Sori globose; veins free; texture leathery, teeth awned.

(*a*) Fronds simply pinnate, margin spinulose-serrate.

1. *P. auriculatum*.

(*b*) Lower pinnæ once pinnate, i.e. fronds bipinnate. Margin with teeth awned.

2. *P. aculeatum*.

1. *Polystichum auriculatum* Sw.

Stipes tufted and scaly. Fronds 12–18 inches long, 2–4 inches broad, pinnate; pinnæ almost sessile, ovate, rhomboidal, falcate, upper base suddenly narrowing, prominently auricled, lower base obliquely cut off; margin spinulose-serrate. Rachis scaly. Texture leathery. Sori in two rows on each side of the midrib.

Distribution: Bombay Presidency—Ghats of the Southern Presidency.

Throughout India and Ceylon.—Formosa.

2. *Polystichum aculeatum* Roth.

Caudex erect. Stipes densely scaly (the scales being awl-shaped or hair-like). Fronds oblong-lanceolate, bipinnate; pinnæ lanceolate with the upper base truncate and more or less auricled and lower base cuneate, pinnate at the base, sometimes nearly to the apex, margin awned. Under surface covered with fine hair-like scales. Texture leathery. [Fig. 41-*c* and *d*.]

Distribution: Bombay Presidency—Ghats of the Southern Presidency.

Throughout India on the mountains. Throughout the whole world.



FIG. 41.—(*a*) *Mesochlæna polycarpa* Bedd. Portion of fertile pinna ($\times 3\frac{1}{5}$).

(*b*) Sorus of same (much magnified).
(*c*) ***Polystichum aculeatum*** Roth. Pinnule (× $4\frac{4}{5}$).
(*d*) Sorus of same (much magnified)
(*e*) ***Cyrtomium falcatum*** Presl. Portion of pinna (× $1\frac{3}{5}$)
(*f*) ***Aspidium cicutarium*** Sw. Portion of frond (× $1\frac{1}{5}$).
(*g*) Pleocnemia membranacea. Portion of frond (× $1\frac{1}{5}$).
(*h*) ***Lastrea calcarata*** Hook. Portion of pinna (× $2\frac{1}{5}$).
(*k*) ***Nephrodium molle*** Desv. Portion of pinna (× $1\frac{3}{5}$).
(*l*) ***Nephrolepis exaltata*** Schot. Portion of pinna (× $1\frac{1}{5}$).
(*o*) A typical sorus of ***f***, ***g***, ***h***, ***k*** and ***l***.

GENUS XXIX.—CYRTOMIUM PRESL.

(Deriv. unknown.)

Indusium round, attached by the centre; veins generally anastomosing with free veinlets proceeding from their junction.

Cyrtomium falcatum Presl.

Caudex erect. Stipes tufted, 6–12 inches long, densely clothed with huge brown scales. Frond 1–2 feet long, lanceolate, pinnate; pinnæ stalked, ovate, acuminate, upper base suddenly narrowed, often auricled, lower base obliquely cut away, margin entire or slightly undulated. Texture leathery. Surfaces naked, shining. Rachis scaly like the stipe. Sori scattered over the under surface. [Fig. 41-*e*.]

The variety *caryotideum* Bedd. has larger, sharply toothed, slightly lobed pinnules, sometimes auricled on both sides at the base. It is scarcely separable from the type and is best considered as a mere form of *C. falcatum*.

Cultivated.

Distribution: Nilgiris at the higher elevations; Himalayas 3,000–8,000 feet; Khasya 3,000–4,000 feet; Ceylon.—China; Japan; South Africa; Sandwich Islands; Madagascar.

GENUS XXX.—ASPIDIUM SCHOTT.

(Sw. in part).

(Deriv. Gr. *Aspidos*, shield—in allusion to the shape of the indusium.)

Veins copiously anastomosing with free included veinlets in the areoles. Sori round. Indusium round or kidney-shaped. Receptacle at the junction of the veinlets or at the apex of free veinlets.

(*a*) Sori copiously scattered irregularly.

1. *A. subtriphyllum.*

(*b*) Sori confined to a distinct row on each side of the principal veins (often scattered in *A. polymorphum*).

(*i*) Pinnæ quite entire or crenate to coarsely toothed. Lateral pinnæ 2–6 pairs, lower ones often forked. Fertile frond often contracted.

2. *A. polymorphum.*

(*ii*) Pinnæ deeply segmented. Lateral pinnæ 1–2 pairs, the lowest pair mostly forked.

3. *A. trifoliatum.*

(*iii*) Pinnæ deeply segmented or pinnate. Lowest pinnæ almost triangular with the lower side always deeply pinnatifid or pinnate.

1. Lateral pinnæ 1–4 pairs. Sori on the connected or free veinlets.

4. *A. cicutarium.*

2. Lateral pinnæ 4–6 pairs. Sori mostly at the apex of the free veinlets.

5. *A. multicaudatum.*

3. Terminal pinnæ three-lobed or sinuately segmented. Lateral pinnæ 4–8 pairs, entire or slightly lobed. Lowest pair forked.

6. *A. macrophyllum.*

1. *Aspidium subtriphyllum* Hook.

Rhizome creeping, scaly. Stipes scaly at the base. Fronds 12–18 inches long, 8–12 inches

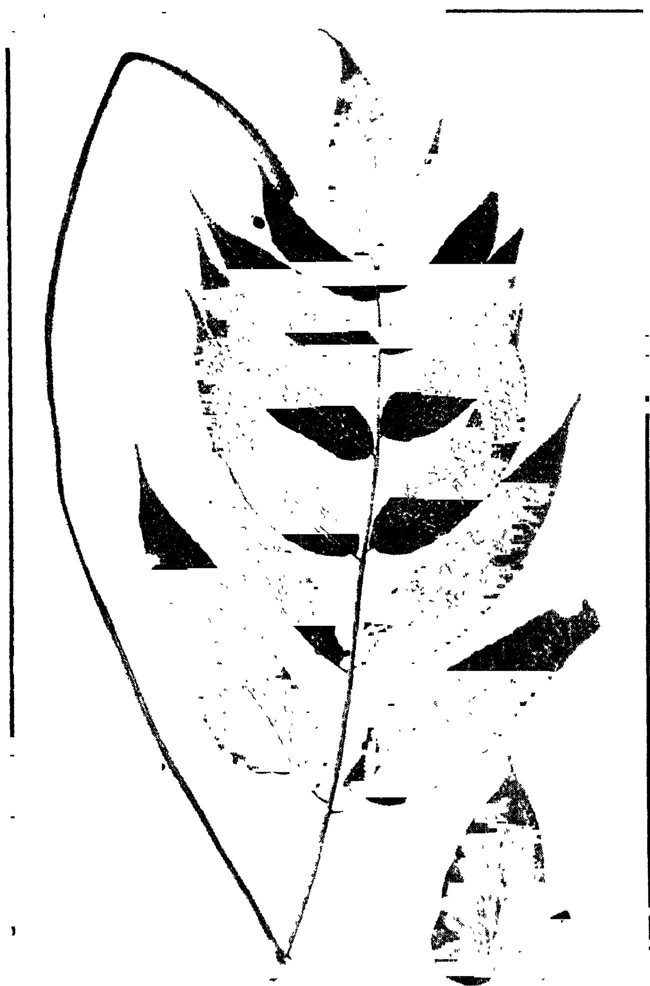
broad, almost triangular, pinnate; terminal pinnæ the largest, rather deeply lobed, lateral pinnæ one or two on each side. Surfaces hairy beneath and on the main veins. Texture herbaceous. Main veins distinct to the edge, veinlets copiously anastomosing with free included veinlets in the areoles. Sori scattered at the junctions of the anastomosing veins. Indusium kidney-shaped. [Plate XII.]

Distribution: Bombay Presidency—North Kanara, Malimani.—Ceylon; Malay Peninsula.

2. *Aspidium polymorphum* Wall.

Rhizome creeping. Stipes tufted, scaly at the base. Fronds large, 1–4 feet long, one foot or more broad, pinnate; terminal pinnæ oblong, or elliptic, acuminate. More or less entire, as large as or larger than the lateral ones; lateral pinnæ 2–6 on each side, oblong or elliptic, acuminate, unequal at the base (sometimes contracted when fertile), quite entire to crenate or coarsely toothed; lower pinnæ often forked. Texture herbaceous or almost leathery. Principal veins distinct to the edge, areoles fine, close, with free included veinlets. Sori large, copious, in two close rows between the main veins. [Plate XI.]

PLATE XI



The smaller fronds of this fern are often cordate, trilobate or trifoliate.

Distribution: Bombay Presidency—North Kanara, Malimani, Jog, Anmode, Cooesi, Supa, Nilkund, Sirsi, Tyagli, Tinai Ghat; Deccan, Mahableshwar; along the higher ghats.

Madras Presidency, western forests up to 4,000 feet; Northern India from Gurwhal to Mishmee and Chittagong; Burma; Ceylon.—Malay Islands; Philippines; Fernando Po.

3. *Aspidium trifoliatum* Sw.

Stipes tufted, scaly. Frond 12–18 inches long, 6–12 inches broad, pinnate; terminal pinna ovate, acuminate, deeply segmented; segments acuminate; lower pinnæ 1–2 pairs, nearly triangular, similarly segmented. Surfaces naked. Texture thin, herbaceous. Main veins distinct to the edge, areoles copious with free included veinlets. Sori in rows near the main veins, indusium round, attached by the centre. [Plate XII.]—Cultivated.

Distribution: Tropical America from Cuba and Mexico to Brazil and Peru.

4. *Aspidium cicutarium* Sw.

Stipes scaly, close to the base. Fronds variable in size and cutting, triangular in outline; terminal pinnæ deeply pinnatifid; lateral ones 1–4 on each side, lobed or pinnate with secondary pinnæ deeply pinnatifid; lowest pinnæ almost triangular with lower side always deeply pinnatifid or pinnate. Texture herbaceous or almost leathery. Surfaces naked, or hairy. Principal veins distinct to the edge; areoles with or without included veinlets. Sori in two rows near the main veins or connected or free veinlets. [Fig. 41-*f* and Plate XII.]

Distribution: Bombay Presidency—North Kanara, very common, Nagargali, Arbail Ghat, Castle Rock; Mahableshwar; Panchgani; Khandala; Matheran very common; Dajipur above Fonda Ghat; Bassein (Nagle Forest); Bassein Range.

Throughout India, from the plains up to 5,000 feet. In the tropics throughout the world.

Also cultivated. Unless we are mistaken as to the identity, specimens of this fern obtained from the Victoria Gardens have fronds proliferous at the ribs.

PLATE XII

Aspidium trifoliatum Sw.



Aspidium sub-triphyllum Hook.

Aspidium microphyllum Sw

5. *Aspidium multicaudatum* Wall.

Stipes densely scaly. Fronds 3–4 feet long with terminal pinnæ cut down nearly to the rachis into lanceolate, acuminate lobed segments, lateral pinnæ pinnatifid, the lowest ones triangular, deeply pinnatifid above, pinnate below. Texture thin, herbaceous. Rachis and surfaces naked. Principal veins distinct to the edges, areoles with free included veinlets. Sori rather large in two rows on both sides of the main veins, nearly all at the apex of the free veinlets.

This is scarcely distinguishable from the largest forms of *Aspidium cicutarium*, but it has, we believe, sori restricted only to the free veinlets.

Distribution: Bombay Presidency—North Kanara, Nilkund.

Khasya Hills, south side up to 1,000 feet elevation; Burma; Anamallay forests.

6. *Aspidium macrophyllum* Sw.

Stipes tufted, scaly below. Fronds 2–3 feet long, one foot or more broad, pinnate; terminal pinnæ either three-lobed or sinuately segmented, the basal segments the longest; lateral pinnæ 4–8, oblong, lanceolate, entire or slightly

lobed; the lowest pair forked at the base. Texture herbaceous. Rachis and surfaces naked. Main veins distinct almost to the edge, areoles copious with free included veinlets. Sori in two rows between each primary vein. [Plate XII.]—Cultivated.

Distribution: Tropical America from Cuba and Mexico to Brazil and Peru.

GENUS XXXI.—PLEOCNEMIA PRESL.

(Deriv. *Pleos*, full; *knemia*, rays—in allusion to the venation.)

As the Aspidium but only the lowest veinlets of the vein anastomosing so as to form a series of areoles near the costa without any free veinlets within them. All the other veinlets as a rule free. Sori generally at the apex of the free veinlets, sometimes on the netted veins.

(*a*) Frond simply pinnate. Stipes covered with persistent black scales.

1. *P. membranifolia.*

(*b*) Frond 2–3 pinnate.

(*i*) Stipes scaly. Sori not mixed with yellow glandular hairs.

2. *P. membranacea.*

(*ii*) Stipes hairy. Sori mixed with yellow glandular hairs.

3. *P. leuzeana*.

1. *Pleocnemia membranifolia* Presl.

Stipes tufted, covered with black scales. Fronds seldom more than one foot long, ovate-triangular, pinnate ; terminal pinnæ pinnatifid ; lateral pinnæ few pairs, more or less deeply pinnatifid ; lowest pair of pinnæ much larger with longer segments on the lower side. Fertile fronds often contracted. Texture herbaceous. Rachis and both surfaces hairy. Some or all of the lowest veinlets connected so as to form a series of arcs next to the costa. Veinlets all free in contracted fertile fronds. Sori generally terminating the free veinlets. Indusium kidney-shaped.

Distribution : Bombay Presidency—North Kanara, Nilkund, Sirsi, Tyagli, Jog, Hoolgeri, Katgal, Hebunkerri, Yan.

East Bengal plains, extending into Assam, Cachar, and Chittagong ; Khasya and Sikkim Hills up to 3,000 feet elevation ; Burma ; Malay Peninsula.

2. *Pleocnemia membranacea* Bedd.

Stipe about a foot long, sparsely scaly below. Frond up to two feet long, triangular, 2–3 pinnate, the lowest pinnæ much the largest, with lowest secondary pinnæ stalked and again quite pinnate at the base, the pinnules being deeply pinnatifid; ultimate segments finely crenate; the upper pinnæ gradually less compound. Texture membranaceous. Surfaces more or less hairy. Lower veins forming costal arches, the rest free or anastomosing. Sori copious, principally marginal in the lobes. [Fig. 41-*g*]

Cultivated.

Distribution: Ceylon.—Java; Philippines; China; Formosa.

3. *Pleocnemia leuzeana* Presl.

Caudex almost a trunk, densely scaly at the crown. Stipes 2–3 feet long, seriated, hairy. Fronds up to six feet long, almost triangular, 2–3 pinnate; pinnæ 1–1½ feet long, 6–8 inches broad, the upper ones simple, the lowest often with 2–3 large, secondary pinnæ from the lower side, which are again pinnate with the pinnules deeply pinnatifid almost to the winged rachis. Ultimate segments oblong-rounded, entire or

finely toothed. Veins anastomosing near the costa, pinnate in the lobes, or all the veins of the segment are free. Sori copious in single rows on each side of midrib mixed with yellow glandular hairs.

Cultivated.

Distribution: North and East Bengal, base of the hills up to 2,000 feet elevation, Sikkim, Assam, Cachar, Khasya, Chittagong, Burma, Malay Peninsula.—Malay Islands; China; Polynesia; North Australia.

Genus XXXII.—Lastrea Presl.

(After Chev. de Lastre, a French nobleman.)

Sori somewhat round on the back or on the apex of veinlets.

Indusium kidney-shaped attached by the sinus. Veins all free. Fronds pinnate or compoundly 2–4 pinnate.

I. Frond pinnate. Pinnæ cut down more than half to the rachis, compound in some forms of felix-mas.

(*a*) Veins all simple.

1. *L. calcarata.*

(*b*) Some veinlets at least forked, disposed in a fan-shaped manner, or pinnate.

(*i*) Texture thin.

1. Pinnæ cut down almost to the rachis into linear spreading, entire oblong lobes. Lower veinlets forked.

   2. *L. thelypteris.*

2. Pinnæ cut down into rounded. sharply serrate segments. Veins disposed in a fan-shaped manner.

   3. *L. odontoloma.*

(*ii*) Texture almost leathery.

1. Pinnæ cut down almost to the rachis into slightly toothed segments; the notch between the segments bearing a tooth. Veins forked.

   4. *L. syrmatica.*

2. Pinnæ cut down into blunt, almost entire, crenate or finely serrate segments; no tooth in the notch between the segments. Veins forked or lower ones pinnate.

   5. *L. felix-mas.*

II. Fronds compound, 2–4 pinnate.

(*a*) Rachis naked or slightly scaly. Surfaces naked.

6. *L. sparsa.*

(*b*) Rachis and surfaces hairy.

(*i*) Fronds pinnate above, bipinnate below, the lower basal pinnules of the lowest pinnæ the longest and equivalent to some of the upper pinnæ in size, shape, and cutting; ultimate segments finely serrate.

7. *L. dissecta.*

(*ii*) Fronds bipinnate; pinnules cut down almost to the costa, oblong, lanceolate from a broad adnate base which is decurrent so as to form a winged rachis; segments either lobed or crenate.

8. *L. tenericaulis.*

(*iii*) Fronds 3–4 pinnate; pinnules often over-lapping; cut down to a winged rachis into oblong ovate segments which are in

turn pinnatifid. Ultimate lobes rounded.

9. *L. crenata.*

1. *Lastrea calcarata* Hook.

Caudex erect. Stipes densely tufted. Fronds up to two feet long, lanceolate, pinnate with pinnatifid apex; pinnæ 1–4 inches long, ½-inch broad, tapering from a broad sessile base towards the apex, cut down about two-thirds or more towards the midrib into linear oblong segments; the lowest segment of the upper side occasionally larger than the rest. Lower pinnæ often reduced to mere auricles. Rachis and surfaces more or less hairy. Veinlets simple. Sori on the back of the veinlets. Indusium kidney-shaped, hairy or naked. [Fig. 41-*h* and Plate XIII.]

Var. *ciliata* Bedd.—The fern occurring in the Presidency is Beddome's variety, *ciliata*, which is characterized by him as follows:—'Texture herbaceous, lowest pinnules deflexed, no auricles on the stem; stipes rounded, pinnæ about four inches long, caudate at the apex, nearly one inch broad; indusium hairy or glabrous'.

Distribution: Bombay Presidency—North Kanara, Anmode, Cooesi, growing on moist

rocks and by the banks of streams, Castle Rock in water-course.

Southern India, very common in all the western forests ; Ceylon ; Khasya ; Himalayas ; Burma.

2. *Lastrea thelypteris* Presl.

Rhizome creeping. Stipes distant. Fronds 1–2 feet long, 4–6 inches broad, pinnate ; pinnæ cut down almost to the rachis into linear spreading, entire oblong lobes, those of the barren frond the broadest, lower pinnæ equalling the others. Surfaces and rachis naked. Texture herbaceous. Upper veinlets simple, lower ones forked.

Cultivated.

Distribution : South India, on the Nilgiris, swamps near Ootacamund ; North India, Kashmir, Bandipoor, City Lake, 5,600 feet elevation, Kunawar, 6,000 feet.—Europe ; North Asia ; North America ; Cape Colony ; New Zealand.

3. *Lastrea odontoloma* Moore

Stipes scaly. Fronds up to 10 inches long, 6–8 inches broad, two-pinnate, with the secondary pinnæ elliptic-oblong cut down into

rounded sharply serrate segments, lower pinnæ not reduced. Texture thin. Veins disposed in a fan-shaped manner. Indusium fringed.

Distribution : Bombay Presidency—Mahableshwar at Kate's Point and along the crest of the hill on the way to Panchgani.

Himalayas, Chamba to Bhotan, 11,000–16,000 feet elevation.

4. *Lastrea syrmatica* Bedd.

Stipes tufted. Fronds 3–4 feet long, 12–18 inches broad, pinnate ; pinnæ 6–9 inches long, $1\frac{1}{2}$–$1\frac{3}{4}$ inches broad, pinnatifid almost to the rachis into slightly toothed segments, the notch between the segments bearing a tooth. Texture almost leathery. Rachis naked. Surfaces naked. Veinlets forked. Sori on the upper veinlet of the fork. Indusium kidney-shaped, naked. [Plate XIII.]

Distribution : Bombay Presidency—North Kanara, Anmode.

South India, not common ; Carcoor Ghat 2,000–2,500 feet ; Anamallays and Travancore hills ; Ceylon, forests of Central Provinces ; North India, Sikkim ; Assam; Khasya ; Burma ; Malay Peninsula.—Philippines.

5. *Lastrea felix-mas* Presl.

Stipes tufted, scaly. Fronds up to four feet long, one foot broad, pinnate-bipinnate ; pinnæ lanceolate, cut down nearly to the rachis into blunt, almost entire, crenate, or finely serrate segments, lower pinnæ sometimes reduced. Texture almost leathery. Rachis scaly. Surfaces sometimes naked, sometimes covered with hair-like scales. Veins forked or the lower ones pinnate. Sori on the back of the veinlets. Indusium kidney-shaped, naked.

The following two varieties occur in the Presidency :—

Var. *elongata* Bedd.—' Lower pinnæ not reduced ; bi-tripinnate or rarely pinnate ; ultimate segments generally narrowed upwards from a broad base, rachises glabrous or scaly.'

Distribution : Bombay Presidency—Mahableshwar.

Southern India, on the western mountains, 4,000–6,000 feet ; Ceylon ; Himalayas and Khasya, 5,000–9,000 feet.

Var. *cochleata* Bedd.—Fronds of two kinds. Sterile ones pinnate, almost bipinnate, lower pinnules lobed. Fertile fronds bipinnate with pinnules much contracted and covered with

prominent involucres in two rows, and completely covering the under-surface.

Distribution : Bombay Presidency—North Kanara, Anshi Ghat ; Mahableshwar.

Southern India, western mountains 2,000–4,000 feet ; North India up to 4,000 feet ; Malay Peninsula.

6. *Lastrea sparsa* Moore

Stipes tufted, scaly. Fronds ovate, 2–3 pinnate ; lowest pinnæ the largest, lower basal pinnules as a rule compound ; pinnules deeply pinnatifid above, less so below. Texture firm, herbaceous. Rachis naked or slightly scaly. Surfaces naked. Sori either terminal on a veinlet or well below the apex. Indusium kidney-shaped.

Distribution : Bombay Presidency—Mahableshwar, on the Yenna near the Falls.

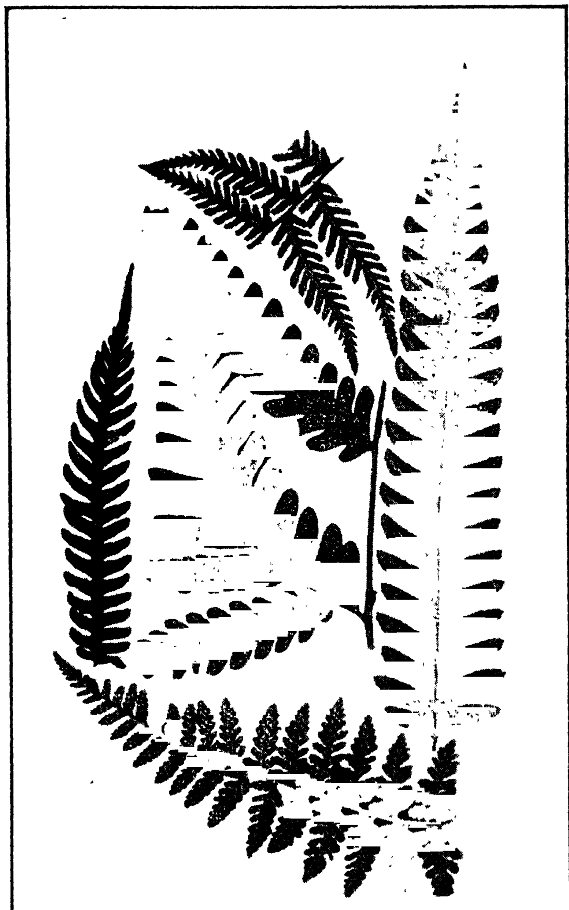
South India, on all the western mountains and on the hills on the east side ; Ceylon ; Himalayas and Khasya, 2,000–6,000 feet ; Burma ; Malay Peninsula.—Malay Islands ; China ; Mauritius.

7. *Lastrea dissecta* Bedd.

Caudex thick, erect. Stipe scaly. Frond triangular to ovate, up to nearly three feet long,

PLATE XIII

Lastrea tenericaulis Bedd., portion of frond.
Lastrea calcarata Hook., a pinna. *Lastrea syrmatica* Bedd., a pinna.



pinnate above, with pinnæ 6–9 inches long, by 1¼ inches broad, cut down two-thirds towards the rachis, bipinnate below, the lower basal pinnules of the lowest pinnæ being the longest and equivalent to some of the upper pinnæ in size, shape, and cutting; ultimate segments finely crenate. Texture herbaceous. Surfaces somewhat hairy. Rachis hairy. Veinlets forked, always free. Sori at the apex of the upper veinlet of the fork, in a single row on each side of the segments. Indusium kidney-shaped, naked. [Plate XIII.]

Distribution: Bombay Presidency—North Kanara, Bilgi, near Meushi.

Madras Presidency, western mountains, common up to about 5,000 feet, North Arcot and Vizagapatam Hills; Ceylon up to 5,000 feet; Burma.—Malay Islands; Polynesia.

8. *Lastrea tenericaulis* Bedd.

Caudex erect. Stipes tufted, slightly scaly below, covered with a bluish bloom which easily rubs off. Frond 1–3 or more feet long, broad ovate-lanceolate, bipinnate; pinnules pinnatifid, almost to the costa, oblong-lanceolate from a broad adnate base which is decurrent so as to form a winged rachis; the segments of the

pinnules either lobed or crenate. Rachis grooved above and hairy, naked beneath; rachis of pinnules also hairy above, naked beneath. Both surfaces hairy along the costa and costules. Veins pinnate with simple veinlets in the larger ultimate segments, only once forked in the smaller segments. Sori on the apex or back of the veins. Indusium deciduous. [Plate XIII.]

Distribution: Bombay Presidency—North Kanara, Siddhapur to Jog, Castle Rock.

South India, on the western mountains 2,000–3,000 feet; Ceylon, 1,500–3,000 feet; North India, Himalayas from no great elevation up to 4,000 feet; Malay Peninsula.—China; Australia; Polynesia.

Also cultivated.

9. *Lastrea crenata* Bedd.

Caudex ascending, densely coated with long, awl-shaped, golden scales, which conceal the bases of the stipes. Stipes brown, scaly only at the base. Fronds up to 1½ feet long, triangular, 3–4 pinnate; pinnæ triangular, pinnules often overlapping, ovate-triangular or ovate-lanceolate, cut down to a winged rachis into oblong-ovate segments, which are in turn

pinnatifid. Ultimate lobes rounded. Texture herbaceous. Rachis more or less hairy. Surfaces hairy. Sori copious on the back of the veinlets, indusium large, pale, hairy. [Plate XIII.]

Distribution : Bombay Presidency—Western Ghats ; Purandhar ; Satara ; Panchgani.

South India, on the Anamallays, Perigoonda Hill, 5,000 feet ; Ceylon ; Himalayas from Gurwhal to Bhotan, 2,000–7,000 feet ; Khasya 2,000–4,500 feet, Chota Nagpur, 2,000–3,000 feet ; Malay Peninsula.—South China ; Mauritius ; Tropical Africa.

Genus XXXIII.—Nephrodium Schott.

(Deriv. Gr. *Nephros*, kidney—in allusion to the shape of the indusium.)

Sori round ; indusium kidney-shaped (often like that of Athyrium or Asplenium in *N. subpectinatum*), sometimes absent. Veins pinnate, one or more of the lower veinlets anastomosing at an angle with corresponding ones of the next group, producing from their junction an ex-current veinlet which is either free or joined in the angle of the next superior pair. Fronds pinnate, pinnæ as a rule pinnatifid.

(*a*) Rhizome wide-creeping. Only one pair of veins anastomosing, rarely two in *unitum*.

(*i*) Venation and sori anomalous.

1. *N. subpectinatum.*

(*ii*) A swamp fern; no auricles on the pinnæ.

2. *N. unitum.*

(*iii*) Sori confined to the lobes.

3. *N. pteroides.*

(*iv*) Venation often as in *Lastrea*, when anastomosing the angle acute at the apex.

4. *N. extensum.*

(*b*) Rhizome erect, sub-erect, or occasionally somewhat creeping in *molle* and *pennigerum* Two or more pair of veins anastomosing occasionally, only one in *molle*.

(*i*) Herbaceous, more or less hairy, auricles present or absent, 1–2 pair of veins anastomose.

5. *N. molle.*

(*ii*) No auricles below, 5-8 pair of veins anastomose, except in fertile contracted frond.

6. *N. pennigerum.*

(*iii*) Stipes covered with hair-like scales, a pair of veins anastomose. Sori on the back of the veins.

7. *N. crinipes.*

(*iv*) Lobes generally square at apex, 2-4 pair of veins anastomose. Lower pinnæ reduced though not to mere auricles.

8. *N. truncatum.*

1. *Nephrodium subpectinatum* Wall.

Rhizome creeping. Stipes scaly below. Fronds 12-15 inches long, pinnate; pinnæ truncate at the base, long tapering at the apex, with shallow serrated lobes, lower pinnæ not reduced. Rachis and surfaces naked. Texture herbaceous. Veinlets pinnate in each lobe, 6-8 on each side, the lowest pair anastomosing at an angle with an ex-current veinlet which

passes to the margin or joins one or two of the upper veinlets. Sori on the back of the veinlets; indusium kidney-shaped, or like that of Asplenium or Athyrium.

Distribution: Bombay Presidency—North Kanara, hill near Nagargli, 2,600 feet.

South India, Anamallay Hills, the dry teak forests 1,000–3000 feet elevation, appearing in the rainy season, Tinnevelly Hills and elsewhere on the Western Ghats, but by no means general; Ceylon 2,000–3,000 feet.—Luzon.

2. *Nephrodium unitum* R. Br.

Rhizome creeping. Stipe naked. Fronds about two feet long, pinnate; pinnæ 3–5 inches long, ½-inch broad, pinnatifid about one-third to the midrib, lobes triangular, sharp pointed; lower pinnæ not reduced. Texture leathery. Rachis and surfaces naked. Veinlets pinnate in each lobe, 4–8 on each side, the lowest pair anastomosing at an angle, with an ex-current veinlet running to the margin or joining one or two of the upper veinlets. Sori on the back of the veinlets, indusium kidney-shaped, hairy.

Distribution: Bombay Presidency—North Kanara, Anmode, Samzode, Sirsi, Katgal, Hebunberri, growing in swampy places and

tanks; Castle Rock, on the banks of the Dhuski River and on the edge of a tank; Dharwar District, Kunnur, under Pandanus, on borders of rice-fields; Goa Territory, near Dood Sagor.

Throughout the Indian region in swampy places.—Tropical Asia, Africa, Australia and America.

3. *Nephrodium pteroides* J. Sm.

Rhizome creeping. Stipes scaly. Fronds up to four feet or more long, two feet broad, pinnate; pinnæ ¾–1 inch broad, pinnatifid about one-third to the midrib, lobes triangular, sharp pointed; lower pinnæ not reduced. Texture herbaceous. Rachis naked or hairy. Upper surface slightly hairy, lower glandular hairy. Veinlets pinnate in each lobe, 7–9 on each side, lowest pair anastomosing with a free ex-current veinlet Sori on the back of the upper veinlets and nearer their apex, confined to the lobes.

Distribution: Bombay Presidency—North Kanara, Kumbarwada, Anshi, Nilkund, Sirsi, Ekambi, Munchkerri, Tyagli, Siddhapur, to Jog, Katgal, growing in dry shady places in evergreen jungle.

Madras Presidency, western mountains, 2,000–4,000 feet; Ceylon, up to 3,000 feet; Burma.—Philippines.

4. *Nephrodium extensum* Hk.

Rhizome creeping. Stipe naked or hairy. Fronds up to four feet long and 1½ feet broad, pinnate; pinnæ about ¾-inch broad, pinnatifid two-thirds to the midrib into linear oblong lobes, lower pinnæ not reduced. Texture herbaceous. Rachis naked or hairy. Upper surface slightly hairy, lower surface glandular hairy. Veinlets pinnate in each lobe; 10–13 on each side, the lowest pair anastomosing with a free ex-current veinlet or meeting at the sinus without the ex-current veinlet, or quite free. Sori towards the apex of the veins.

Distribution: Bombay Presidency—North Kanara, Sirsi, Munchkerri, growing in swampy places.

South India, Tinnevelly Hills; Ceylon, Central Provinces, 3,000–4000 feet; Burma; Penang; Malay Peninsula; Malay Islands.

5. *Nephrodium molle* Desv.

Rhizome erect or creeping. Stipes hairy, scaly or naked. Fronds 1–3 feet long, pinnate;

pinnæ 4–6 inches long, ¾-inch broad, pinnatifid half-way to the midrib into oblong lobes; lower pinnæ more or less reduced, often to mere auricles, sometimes not at all. Texture herbaceous. Rachis hairy, scaly or naked. Surfaces hairy or naked. Veinlets pinnate in the lobes, 6–8 pair, the lowest pair (rarely two) anastomosing at an angle with an ex-current veinlet. Sori on the back of the veins. Indusium kidney-shaped, hairy or naked. [Fig. 41-*k*.]

Distribution: Bombay Presidency—North Kanara, Sirsi, Katgal, Devaraya (Madras and Southern Mahratta Railway cutting), Ekambi, Tinai Ghat, Castle Rock; in Goa Territory, Mapuca in wells, Marmagoa, and along the railway line as far as Dood Sagor watercourse; Mahableshwar, Panchgani; Konkan; Vetora in coconut groves and along water, Amboli Hills; Ambowne in well-pit; Matheran; Bombay Island, Mahim in wells.

Throughout the Indian region from the plains up to 6,000 feet. All over the world in tropical and sub-tropical regions.

Also common in cultivation in the Presidency.

6. *Nephrodium pennigerum* Hk.

Rhizome erect or creeping. Stipes hairy or naked. Fronds up to 4 feet long, pinnate; pinnæ 8–10 inches long, 1–1½ inches broad, pinnatifid about ¼ to the midrib into blunt lobes; lower pinnæ not reduced. Texture herbaceous. Rachis and surfaces hairy. Veinlets pinnate in the lobes, 8–12 on each side, 5 or 6 (rarely three) lower ones anastomosing with an ex-current veinlet. Sori on the back of the veinlets; indusium kidney-shaped.

Distribution: Bombay Presidency—North Kanara, Tyagli, Jog, Yan, Mankibile.

South India, in all the western mountain forests; Ceylon, Central Provinces, 2,000–4,000 feet; East Bengal, from Mishmee to Chittagong at no great elevation; Malay Peninsula.—Malay Islands; Tropical Africa.

7. *Nephrodium crinipes* Hk.

Rhizome erect or creeping. Stipes densely covered with narrow hair-like scales. Fronds 2–3 feet long, pinnate; pinnæ 4–6½ inches long, ½–¾ inch broad, pinnatifid ½–¾ towards the midrib; lobes oblong; lower pinnæ reduced to mere auricles. Texture herbaceous. Rachis scaly. Surfaces naked. Veinlets pin-

nate in the lobes, 6–8 on each side, the lowest two pair anastomosing with an ex-current veinlet. Sori on the back of the veins but a little nearer the apex than the costule; indusium kidney-shaped, naked.

Distribution: Bombay Presidency—North Kanara, Jog, Sumkund, Katgal. Growing in swampy places.

Malacca; North-East Bengal, up to 1,500 feet from Nepal to Assam and Chittagong.

8. *Nephrodium truncatum* Presl.

Rhizome erect or creeping. Stipe naked or hairy. Fronds up to 4 feet long, pinnate; pinnæ up to 11 inches long, 1$\frac{3}{8}$-inch broad, pinnatifid about half-way to the midrib into blunt lobes, more or less square at the apex; lower pinnæ reduced, though not to mere auricles. Texture herbaceous. Rachis hairy or naked. Surfaces hairy or naked. Veinlets pinnate in the lobes, 6–9 on each side, two (rarely 3–4) lowest ones anastomosing, with an ex-current veinlet. Sori on the back of the veins, nearer the costule than the margin; indusium kidney-shaped.

Distribution: Bombay Presidency—North Kanara.

South India, Tinnevelly and Travancore Hills; Ceylon, Central Provinces, 2,000–5,000 feet; Cachar and Chittagong Hills at no elevation; Malay Peninsula.—Malay Islands; North Australia; Polynesia.

GENUS XXXIV.—NEPHROLEPIS SCHOTT.

(Deriv. Gr. *Nephros*, kidney; *lepis*, scale—in allusion to the indusium being kidney-shaped and scale-like.)

Sori round, indusium kidney-shaped or roundish; veins forked, free, with club-shaped apices. Fronds simply pinnate, pinnæ articulated and furnished with white dots above.

I. Rhizome erect, stoloniferous.

(*a*) Sori about midway between edge and midrib. Rhizome often bearing tubers.

(*i*) Plant sturdy in habit. Texture leathery. Indusium leathery.

1. *N. cordifolia.*

(*ii*) Plant delicate in habit. Texture membranaceous. Indusium thin.

2. *N. undulata.*

(*b*) Sori nearer the margin. Rhizome never bearing tubers.

(*i*) Fronds drooping; pinnæ up to eight inches long, $1\frac{3}{8}$ inches broad, acuminate; upper base rarely shortly auricled.

3. *N. acuta.*

(*ii*) Fronds erect; pinnæ 2–3 inches long, $\frac{1}{4}$–$\frac{1}{2}$ inch broad, acute; base always distinctly auricled, the upper auricle the larger.

4. *N. exaltata.*

(*iii*) Pinnæ laciniate, covered with ferruginous hairs.

5. *N. rufescens.*

II. Rhizome climbing.

6. *N. volubilis.*

1. *Nephrolepis cordifolia* Baker

Caudex almost erect, giving off wiry fibres (stolons) bearing tufts of fronds at intervals and often bearing tubers.

Stipes tufted, wiry, scaly. Fronds up to two feet long, pinnate; pinnæ 1–$1\frac{1}{4}$ inches long, $\frac{1}{2}$–$\frac{5}{8}$ inch broad, margin entire or crenate, lower base rounded or cordate, the upper base distinctly auricled. Texture leathery. Rachis

slightly scaly. Surfaces almost naked. Sori in a single row about midway between edge and midrib. Indusium firm, kidney-shaped.

Distribution: Bombay Presidency—North Kanara, Ekambi, growing on Caryota urens; Mahableshwar on trees; Panchgani.

Throughout India up to 5,000 feet.—Japan; New Zealand; tropics of the whole world.

Common in cultivation. It has run wild on Malabar hill.

Var. *Duffii.*—This is a wild variety with pinnæ reduced to mere auricles.

Cultivated.

2. *Nephrolepis undulata* J. Sm.

Caudex almost erect, giving off a number of wiry filiform stolons which bear tubers. Stipes usually arising in twos from the caudex, naked or nearly so. Fronds slender, drooping, up to 2 feet long, 1½ inches broad, pinnate; pinnæ ¼-inch broad, apex acuminate, acute or rounded; margin crenate or incised-crenate, with crenatures often again crenate. Rachis naked; surfaces naked. Texture thin, membranaceous. Sori rounded, indusium kidney-shaped, thin.

This species has not up to now been recorded

to occur in India and seems to have been lumped together with *Nephrolepis cordifolia.* A specimen wrongly named *Nephrolepis ramosa* (Beauv.) in the Bombay Natural History Society's Herbarium is this fern. Of it Mr. Macpherson says:—'It is an annual dying down shortly after the rains.' The book has the following note on a specimen of this fern collected by Mr. Woodrow in the caves at Panchgani. 'I can make nothing of this but *Nephrolepis cordifolia*, but the pinnæ are more membranaceous in texture than the fern usually is. The fact of its growing in a cave may account for this.'

We consider it to be distinct from *N. cordifolia.* It is an annual, whereas *N. cordifolia* is perennial, it is a more delicate fern than *N. cordifolia* and has membranaceous involucres. The specimens we have examined answer well the description and figure of *N. undulata* given in Lowes' *Ferns, British and Exotic*, vol. vii, pp. 51 and 52. Accordingly we have placed them in this species.

Distribution: Bombay Presidency—North Kanara, Karwar, Anshi Ghat at no elevation, Sumkund; Lonavla on trees; Panchgani in caves.—West Africa; Sierra Leone.

3. *Nephrolepis acuta* Presl.

Rhizome erect, stoloniferous. Stipes tufted, naked, or scaly. Fronds up to eight feet or more long, drooping; pinnæ up to eight inches long, 1⅜ inches broad, acuminate, margin crenate or the crenatures again crenate, upper base rarely shortly auricled, lower base rounded. Surfaces and rachis hairy when young but naked in age. Texture almost leathery. Sori near the margin. Indusium kidney-shaped or almost round.

Distribution: Bombay Presidency.—North Kanara, Supa, pendent from dripping rocks.

South India, on the North Arcot Hill at no great elevation; Ceylon; North India; Chittagong Hills up to 1,000 feet.—Tropical Africa..

Also cultivated in gardens.

Var. *furcans* having the pinnæ once or more forked is common in gardens. It is wrongly advertised and known as *N. davallioides* var. *furcans* not noticed by us in Bombay.

4. *Nephrolepis exaltata* Schott.

Rhizome almost erect, giving off numerous wiry creeping stolons. Stipes tufted, scaly. Fronds 1–3 feet long, 3–6 inches broad, pinnate;

pinnæ 2–3 inches long, ¼–½ inch broad, acute at the apex, margin entire or crenate; base auricled, the upper auricle the larger. Rachis and surfaces scaly when young, but naked in age. Texture almost leathery. Sori near the margin. Indusium firm, kidney-shaped. [Fig. 41-*l*.]

Distribution: Bombay Presidency—North Kanara,—Jog, Kyga Ghat, Sumkund, Sirsi, Tyagli, Honowar, Kasurgode, Devarayi, Gersoppa Falls (on rocks in river-bed); Bombay Island, Sion and Rowli Hills.

South India, mountain forests of the Eastern and Western sides; East Bengal from Assam to Chittagong, up to 1,000 feet; Ceylon; Malay Peninsula.—In the tropics of nearly the whole world.

Common in cultivation. Specimens occurring at Sion and Rowli Hills are probably escapes from cultivation. On Malabar Hill this fern has run wild.

5. *Nephrolepis rufescens* Presl.

This is probably a variety of *Nephrolepis acuta*. It has laciniated pinnæ covered with ferrugineous hairs.

Cultivated.

6. *Nephrolepis volubilis* J. Sm.

Rhizome climbing and bearing at intervals, lateral spurs covered with chestnut scales. Stipes tufted on the spurs, scaly. Fronds pinnate; pinnæ oblong, blunt, crenate, base suddenly narrowing and slightly auricled on the upper side. Surfaces naked. Texture rather leathery. Sori near the margin; indusium firm, kidney-shaped.

Genus XXXV.—Oleandra Cav.

(The fronds resemble Oleander leaves.)

Sori round, in a single row on each side of the midrib. Indusium kidney-shaped. Fronds entire. Stipes pointed. Rhizome wide-creeping.

Oleandra musaefolia Kunze.

Rhizome wide-creeping, covered with long golden scales. Stipes 1–2 inches long, jointed quite near the base. Fronds single or more rarely in tufts; 12–20 inches long, 1½ inches broad, lanceolate, elliptical, acuminate. Texture membranaceous, both surfaces hairy. Midrib scaly below.

Distribution: Bombay Presidency—Panchgani.

South India, on the western mountains, particularly abundant in Coorg, rare elsewhere; Ceylon, Central Provinces.

(B) *Exinvolucratæ.*

Sori without an indusium.

TRIBE X.—POLYPODIEÆ

Sori on the back of the lobes, round or rarely somewhat oblong.

Desmobryoid Series.—Habit and mode of growth of Aspidieæ, the stipes continuous with the caudex; sori generally medial on the veins.

GENUS XXXVI.—PHEGOPTERIS FEE

(Deriv. *Phegos*, beech—the beech-fern.)

Veins forked or pinnate, veinlets free. Habit of Lastrea, but indusium wanting.

Phegopteris ornata Bedd.

Caudex erect. Stipes covered with awl-shaped scales, or rough owing to the persistent bases of the scales. Fronds up to twenty feet long, three-pinnate; the ultimate pinnules oblong, often deeply incised, their bases being connected by a broad wing on the tertiary rachis. Texture thin, herbaceous. Main and partial rachises rough and scaly and furnished with fine pointed hairs. The latter occur also

on the veins. Veinlets simple or forked. Sori on the back of the veins, one corresponding to each segment of the pinnule.

Distribution: Bombay Presidency—North Kanara.

South India, Carcoor Ghat, Malabar and elsewhere along the Western Ghats; Himalayas from Kumaon to Bhotan, in tropical valleys up to 2,000 feet; Chittagong Hills, 500 feet; Malay Peninsula.—North Australia, Polynesia.

Genus XXXVII.—Goniopteris Presl.

(Deriv. Gr. *Gonia*, angle; *pteris*, fern, the veinlets meeting and forming angles.)

Habit and venation of Nephrodium, i. e. fronds pinnate, veins pinnate, one or more of the lower veinlets anastomosing at an angle with corresponding ones of the next group producing from their junction an ex-current veinlet. Indusium wanting.

Goniopteris prolifera Presl.

Rhizome stout, creeping. Stipes tufted, very variable in length. Fronds pinnate of two kinds; some of them very long, whip-like and prostrate, with the pinnæ much reduced and almost triangular or rounded. Such fronds often root at the apex and produce buds in the

axils giving rise to new plants. These fronds are always sterile. Others are not so long and have longer bluntly lobed or crenated pinnæ. Rachis and lower surface often slightly hairy. Texture herbaceous to almost leathery. Veinlets fine, 6–10 on each side anastomosing at an angle with an ex-current veinlet connecting the angles. Sori medial, fine, oblong or even confluent in age (meniscoid).

Distribution: Bombay Presidency—North Kanara, Jog, Birchi, Kalinadi, Supa, Anmode (in a stream), Kadra. Growing in the beds of rivers, Dharwar District, banks of a stream near Kunamalihalli; Konkan.

Throughout the Indian region in the plains or low down in the hills.—North Australia; Tropical and South Africa and its Islands; Philippines; New Caledonia; South China.

Eremobryoid Series.—Stipes articulated with the rhizome: Sori generally, not always, terminal on the veins.

GENUS XXXVIII.—NIPHOBOLUS KAULF.

(Deriv. Gr. *Niphos*, of snow; *bolus*, a large scale—in allusion to the snowlike scales and large sori.)

Sori round or oval, superficial or buried in the hairs. Fronds as a rule simple, covered beneath with a dense coating of stellate hairs. Veins copiously anastomosing, obscure, undefined or evident with the main veins prominent. Fertile fronds more or less contracted and longer than the sterile.

Niphobolus adnascens Kaulf.

Rhizome long, creeping, scaly. Stipes scaly. Fronds 2–8 inches long, simple, entire ; of two kinds, the barren ones oval-lanceolate ; the fertile ones narrower, linear-lanceolate with the apex blunt or acute. The upper surface smooth and green, the lower covered with stellate (star-shaped) hairs, often very densely. Texture fleshy to leathery. Midrib prominent, veins immersed in the substance of the frond, anastomosing, the areoles including 2–4 free veinlets which are club-shaped at their apices. Sori often restricted to the upper half of the frond, reddish brown in colour ; sporangia mixed with long-stalked stellate hairs.

In some specimens examined by us the distinction between sterile and fertile fronds does not exist.

Distribution : Bombay Presidency.—North Kanara, Karwar on trees ; Konkan jungles ; Vetora (Savantwadi State) on trees and rocks ; Goa and Savantwadi ; Bombay Islands, Sion Wood on mango tree ; Salsette, Bandara Hill on mango trees.

Throughout India from the plains up to 4,500 feet ; Ceylon ; Malay Peninsula.—China ; Fiji ; Mascareen Islands ; Cameroon Mountains.

Genus XXXIX.—Drynaria Bory

(Deriv. *Dryads*, the sterile fronds resembling oak-leaves, a tree sacred to the Dryads.)

Rhizome short, thick and fleshy. Fronds rigid, the sterile when present like an oak-leaf ; fertile frond pinnatifid or pinnate, rarely simple. Veins copiously anastomosing forming square or hexagonal areoles. Sori small, round or oval, numerous.

Drynaria quercifolia Bory

Rhizome short, thick and fleshy, densely coated with red-brown hair-margined scales which are cordate at the base. Fronds of two kinds : the sterile ones smaller, becoming brown with age, cordate ovate, variously lobed, sometimes shallowly, sometimes rather deeply,

though not to such an extent as the fertile ones; fertile fronds long-stalked, the base often decurrent on the stipes, cut down almost to the midrib into elongated acuminate segments. Surfaces naked. Texture membranaceous to leathery. The costa or midribs of each segment give rise to the costules or lateral branches which run to the margin and are connected by transverse veins forming 4–6 primary *areoles* each including a number of smaller areoles with or without free veinlets. Sori two in each primary areole.

Distribution: Bombay Presidency—North Kanara, Karwar, abundant on trees and rocks; Savantwadi, on trees and rocks; Goa, Old Goa on trees; Konkan, Matheran, on trees; Mahableshwar; Salsette on roots of trees.

Throughout the Indian region in the plains or low down on the mountains.

Also occurs in cultivation in Bombay. The cultivated forms of this fern are more sturdy and rigid than the ones growing wild.

GENUS XL.—PLEOPELTIS H. AND B.

(Deriv. *Pleos*, full; *peltis*, shield—the sori often furnished with round scales.)

Fronds simple, pinnatifid or pinnate. Veins copiously anastomosing with free included veinlets.

I. Fronds simple.

(*a*) Main veins not distinct to the edge.

(*i*) Under-surface naked.

1. Fronds 6–12 inches long, $\frac{1}{2}$–$\frac{3}{4}$ inch broad. Texture coriaceous. Sori never sunk in a cyst.

1. *P. linearis.*

2. Fronds larger, up to two feet long by 1–2 inches broad. Texture thinner. Sori deeply sunk in a cyst.

2. *P. simplex.*

(*ii*) Under-surface clothed with small peltate scales.

3. *P. lanceolata.*

(*b*) Main veins distinct to the edge or nearly to the edge.

(*i*) Texture thin, membranaceous. Venation distinct, prominent.

4. *P. membranacea.*

(*ii*) Texture fleshy, leathery. Venation sunk, distinct when dry.

5. *P. punctata.*

II. Fronds deeply pinnatifid.

6. *P. phymatodes.*

1. *Pleopeltis linearis* Bedd.

Rhizome wide-creeping, scaly. Fronds simple, entire, linear-lanceolate up to twelve inches long and scarcely an inch broad. Surfaces naked or nearly so. Texture leathery. Venation indistinct, reticulated, the meshes including free forked veinlets. Sori large, prominent, arranged in two rows on each side of the midrib and half-way between the latter and the margin. Each sorus consists of clusters of sporangia intermixed with peltate long-stalked scales.

The fronds of this fern roll up after the rains, remaining green and leathery, and so resist the dry season.

Distribution: Bombay Presidency—North Kanara, Castle Rock, Gersoppa Falls; Konkan jungles; Matheran on trees; Amboli Hills; Mahableshwar on trees; Purandhar.

Himalayas, 1,000–10,000 feet; Khasya; throughout South India; Ceylon; Malay Peninsula.—Malay Islands; China; Japan; Central and South Africa and its islands.

2. *Pleopeltis simplex* Sw.

This fern differs from the last in having larger fronds, thinner texture and more distinct venation, and in the sori being sunk so much so that the upper surface is blistered just opposite to the sori.

Distribution: Bombay Presidency—North Kanara; Panchgani.

Himalayas.

3. *Pleopeltis lanceolata* Presl.

Rhizome creeping, scaly. Fronds 3–9 inches long, $\frac{1}{4}$–$\frac{3}{4}$ inch wide, lanceolate, tapering at both ends. Surfaces, especially the under-surface, covered with small peltate roundish scales. Texture leathery. Venation indistinct, reticulate, the main veins forming large obliquely elongated meshes, within which are irregular smaller meshes with a few free veinlets rarely forked. Sori large, prominent, one row on each side of the midrib and midway between the latter and the margin. Each sorus consists of

sporangia intermixed with long-stalked peltate scales.

It is distinguished from the two previous species chiefly by the peculiar venation.

Distribution: Bombay Presidency—North Kanara, Yan.

Nilgiris and higher mountains on the west side of the Madras Presidency; Assam; Ceylon, Ambawatta estate.—Tropical America; West Indies; South Africa and its islands; St. Helena; Sandwich Islands.

4. *Pleopeltis membranacea* Bedd.

Rhizome short, creeping, stout, somewhat scaly. Fronds 6 inches–⅔ foot long, less than an inch to six inches broad, lanceolate, tapering at both ends, entire or irregularly lobed or sinuate. Texture thin, membranaceous. Venation distinct; main veins connected by transverse ones so as to form large meshes which include smaller meshes with simple or forked free veins. Sori on the junctions of the veinlets in two series between the costules or more or less irregularly disposed.

Distribution: Bombay Presidency—North Kanara, Godhullie, Castle Rock, on trees common; Mahableshwar on trees common;

Panchgani, north side of Tableland, near caves, on the way of Tableland ; Matheran on rocks and trees ; Khandala on trees abundant ; Lonavli ; Igatpuri on rocks, Igatpuri Ghats.

Himalayas, from Gurwhal to Bhotan, 3,000–8,000 feet ; Khasya, 2,000–5,000 feet ; Chota Nagpur, Parasnath ; South India, mountains on both sides of the Madras Presidency, 2,000–5,000 feet ; Ceylon.

Dies down after the rains.

5. *Pleopeltis punctata* Bedd.

Rhizome stout, scarcely creeping, scaly. Stipe short, often absent. Frond 1–3 inches broad, simple, entire, lanceolate with the apex acute or blunt. Surfaces naked. Texture fleshy-leathery. Venation sunk, distinct when dry. Main veins distinct to the margin and connected by transverse ones so as to form large meshes which include smaller meshes with free simple or forked veinlets. Sori on the junction of the veinlets irregularly deposed, usually restricted to the upper half of the frond.

Distribution: Bombay Presidency—North Kanara, Tyagli, Kansur.

South India, western mountains up to 3,000 feet ; Ceylon ; North India, in the Bengal

plains and up to 3,000 feet; Malay Peninsula.—China; Malay Islands; North Australia; Polynesia; Southern and Central Africa and its islands.

Also cultivated.

6. *Pleopeltis phymatodes* Bedd.

Rhizome wide-creeping, woody and clothed with dark brown hair-like scales. Stipes 3–12 inches or more long, firm, erect, smooth. Fronds 6 inches to 3 feet long, varying from simple oblong-lanceolate to deeply pinnatifid lobes, numerous, entire, acuminate, lanceolate, oblong, 4–8 inches long by 1–1½ inches broad. Texture leathery. Both surfaces naked. Main veins not distinct, areoles fine with free veinlets. Sori large, rather sunk in one or two rows, scattered.

Commonly cultivated; often grown in hanging baskets.

Distribution: Ceylon; Malabar and Travancore, cultivated only (?); Malay Peninsula.—Throughout the tropics of the old world, the continent of India excepted.

TRIBE XI.—GRAMMITIDEÆ

Sori on the back of the lobes, more than twice as long as broad, usually linear.

GENUS XLI.—GYMNOGRAMME DESV.

(Deriv. Gr. *Gymnos*, naked; *gramme*, writing.)

Sori arising from the veins over the under surface of the frond, linear and usually forked. Habit and mode of growth of Cheilanthes.

(*a*) Fronds very small, 2–4 inches long. Under surface not powdery.

1. *G. leptophylla.*

(*b*) Fronds very large, 1–3 feet long. Under surface coated with white or yellow powder.

2. *G. calomelanos.*

1. *Gymnogramme leptophylla* Desv.

Roots fine, fibrous, tufted. Stipes 1–4 inches long, tufted, brown polished, filiform.

Fronds 2–4 inches long, 1–1½ inches broad, pinnate to tripinnate, pinnæ or pinnules spathulate or obovate, deeply lobed with the lobes entire or finely serrate. Texture thin, membranaceous. Veins simple or forked. Sori oblong, simple or forked.

This is a very delicate annual appearing in the rains and dying down soon after.

Distribution: Bombay Presidency—Mahableshwar, Satara Fort walls.—Western Ghats

of the Peninsula of India, Ootacamund.—Europe; The Azores; Madeira; Canaries; Africa; Persia; Australia; New Zealand; South America.

2. *Gymnogramme calomelanos* Kaulf.

Caudex upright. Stipes tufted, 6–12 inches long, scaly below and together with the rachis black polished. Fronds 1–3 feet long, 6–12 inches broad, oblong-triangular, tripinnatifid, with lanceolate acuminate pinnules and lengthened acuminate lobed segments. Upper surface dull green, naked; lower surface covered with white powder. Texture almost leathery or herbaceous.

Distribution: Bombay Presidency—Khandala and Kampoli; Dango Forest (Surat); Bombay Island, Malabar Hill, Sewrie, Rowli Hill, Sion Wood.—Nilgiris; Ceylon.

It is a native of the West Indies, Jamaica, St. Domingo, Guiana, Brazil, Mexico, the island of St. Catherine, the Carriba Islands, etc.

It is a fine graceful species and is classed among the silver ferns from the under-side of the fronds being covered with a farinose powder.

It propagates freely by spores and this probably accounts for its having run wild in and about Bombay. It is particularly abundant on hill sides which have been cut down for reclamation purposes. It prefers a bright open situation as is evidenced by its greater abundance on the sunny hill sides at Rowli than in the shade of the Sion Wood. The hill sides also allow of free drainage without which the fern cannot thrive.

In cultivating this fern, therefore, a sunny situation and free drainage are required.

Var. *chrysophylla* (*Gymnogramme chrysophylla* Kaulf.)—It is a smaller fern than the type and the powder is bright yellow.

It is the ‘ King of Gold Ferns ’ and is universally admired.

It is becoming naturalized on the Nilgiris. It is a native of South America and the West Indies.

GENUS XLII.—VITTARIA SM.

(Deriv. *Vitta*, a riband; the riband-shaped frond.)

Veins simple, forming an acute angle with the midrib and having their apices prolonged into a transverse marginal vein which eventually

becomes the receptacle. Sori situated in a longitudinal slit of the margin. Fronds simple, linear, grass-like.

Vittaria elongata Sw.

Rhizome creeping, clothed with scales having black hair-like points. Stipes short. Fronds up to 4½ feet long, ¼-inch broad, simple, linear acuminate, (grass-like) pendulous. Surfaces smooth, naked. Texture fleshy to almost leathery. Midrib prominent beneath, veins sunk in the substance of the frond, proceeding at an acute angle from the midrib, almost parallel, their apices connected by a transverse intramarginal vein. Sori linear, continuous, quite sunk in the marginal grove. [Fig. 42.]

Distribution: Bombay Presidency—North Kanara, on trees, Sumkund.

South India, on the western mountains, 2,000–5,000 feet; Ceylon, Central Provinces; North India from the plains up to about 4,000 feet; Malay Peninsula; Burma, etc.—Malay Islands; Queensland; Polynesia; Tropical Africa; Mauritius.

GENUS XLIII.—HEMIONITES L.

(Deriv. *Hemionos*, a mule—the mule-fern.)

Veins, reticulated and wholly covered by sporangia, the sori being in fact reticulated. Fronds either simple, pinnatifid or pinnate.

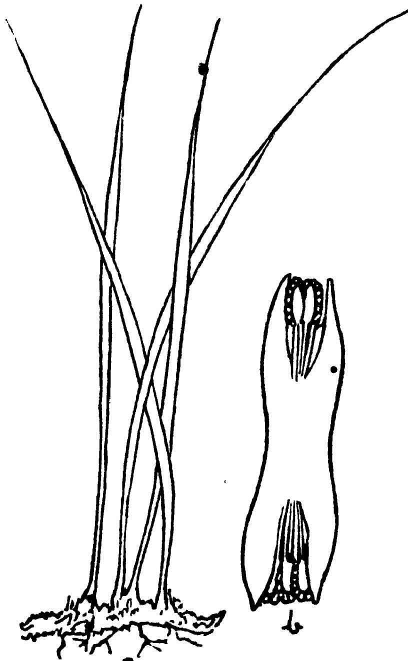


FIG. 42.—*Vittaria elongate* Sw.

(*a*) Complete plant ($\times \frac{1}{8}$).

(*b*) Vertical section through frond showing the position of the sori (much magnified).

Hemionites arifolia Bedd.

Caudex short, erect. Stipes dark-brown, polished, hairy, those of the fertile frond longer than those of the barren. Fronds 2–3 inches each way. Barren frond heart-shaped, ovate, with a deep notch at the base, apex and basal lobes rounded. Fertile frond halberd-shaped with the basal notch not so deep and the basal lobes and the apex more pointed. Upper surface dark green, naked, under surface pale green; hairy. Venation reticulated, meshes obliquely elongated and rarely having free included veinlets. Sori continuous along the veins and reticulate.

Distribution: Bombay Presidency—Southern Ghats and in Kanara.

South India in the plains and in the mountains up to nearly 3,000 feet; East Bengal plains; Ceylon; Burma.—Philippines.

It grows in dry localities. Cultivated in gardens in Bombay.

TRIBE XII.—ACROSTICHEÆ

Sori spreading over the whole under-surface or rarely over both surfaces of the frond, not confined to the veins only. Fertile fronds or segments always more or less contracted.

GENUS XLIV.—STENOCHLÆNA J. SM.

(Deriv. Gr. *Stenos*, narrow; *chlæna*, cloak—in reference to the narrow involute margin.)

Fronds of two forms; the fertile fronds contracted and very narrow; the barren fronds simply pinnate; the pinnæ leathery in texture; veins simple or forked, fine and close, generally quite free to the margin, rarely anastomosing; stipes adherent to the rhizome; pinnæ articulate with the rachis.

Stenochlæna palustre Bedd.

Rhizome slender, climbing, and covered with long narrow scales. Stipe adherent to the rhizome. Fronds 1–4 feet long, of two kinds, pinnate; pinnæ articulated with the rachis, linear lanceolate, acuminate, wedge-shaped at the base, margin cartilaginous, spinulose serrate, especially towards the apex; pinnæ of the fertile frond much contracted. Surfaces naked, shining. Texture hard, leathery. Rachis of the sterile pinnæ winged. (This wing has been looked upon as a transverse vein anastomosing in loops parallel with the costa.) From the wing proceed towards the margin a large number of close parallel veins which are either simple or forked, free or seldom anastomosing.

Distribution: Bombay Presidency—North Kanara, climbs to the top of the highest trees; Goa and Savantwadi.

South India, in the plains of the West Coast and up the mountains to about 3,000 feet; Ceylon; North India, in the plains of Bengal and at low elevations on the hills; Malay Peninsula—South China; Queensland; Fiji.

Genus XLV.—Polybotrya H. B. K.

(Deriv. *Poly*, many; *botrys*, bunch—in allusion to the fructification.)

Fronds pinnate, bipinnatifid or almost pinnate, bipinnate; sterile frond generally proliferous; fertile frond much contracted; veins pinnate, all free; stipes adherent to rhizome.

Polybotrya appendiculata Bedd.

Rhizome creeping. Stipe scaly. Sterile fronds often proliferous at the apex, pinnate; pinnæ 25–50 pair, 2–3 inches long, ½-inch broad, oblong, lanceolate, cut down, often deeply, into blunt lobes with a bristle in the notch between the lobes, the upper base often auricled, the lower obliquely cut off. Fertile fronds much contracted with the pinnæ much shorter. Surfaces naked. Rachis often scaly. Texture

membranaceous to almost leathery. Veins pinnate, free.

Distribution: Bombay Presidency—North Kanara: Siddhapur, Jog, Castle Rock, in shade of trees; Belgaum; on the ghat at Ghotne, east of Ratnagiri; Amboli; Matheran.

Throughout the Indian region—Philippines; Hongkong.

Var. *aspleniifolia* Bedd.

Rachis very scaly, pinnæ very unequal sided, the inferior basal portion being much cut away; the upper side much deeper cut than the type.

Distribution: Bombay Presidency—North Kanara.

South India in moist ever-green forests on the western side up to nearly 4,000 feet.

Genus XLVI.—Gymnopteris Bernh.

(Deriv. *Gymnos*, naked; *pteris*, a fern seeding naked.)

Veins copiously anastomosing with free veinlets in the meshes; main veins distinct or not distinguished from the rest; fronds simple or pinnate, generally of two forms, the fertile being much contracted, or rarely simple and

all similar, bearing the sori on the contracted apex; stipes adherent to the rhizome.

(*a*) Barren frond entire.

1. *G. variabilis.*

(*b*) Barren fronds sometimes simple, but at least one or two pairs of distinct pinnæ when fully developed.

(*i*) Barren fronds more or less oak-leaf-shaped consisting of a lobed terminal pinna and a pair of unequal sided lateral pinnæ.

2. *G. quercifolia.*

(*ii*) Barren fronds simple, trifoliate or pinnate, the terminal pinnæ being elongated and proliferous.

3. *G. flagellifera.*

(*c*) Barren fronds copiously pinnate.

(*i*) Main veins conspicuous two-thirds of the way to the margin; meshes abutting on the costa without any included veinlets, others including several veinlets which are either free with elevate apices or join with the mesh above.

4. *G. contaminans.*

(*ii*) Main veins conspicuous almost to the margin; veinlets anastomosing at right angles, from which proceed 1–2 free veinlets with clavate apices.

5. *G. subcrenata.*

(*iii*) Main veins indistinct; veinlets meeting at acute angle from which proceeds a veinlet which is either free or joined to the veinlet above; marginal veinlets free terminating in a dot within the margin.

6. *G. presliana.*

1. *Gymnopteris variabilis* Bedd.

Rhizome creeping, scaly. Sterile frond a foot or more long and 1–2½ inches wide, simple, entire, lanceolate, base gradually narrowing into the stipe, apex acuminate or acute. Fertile frond much contracted, often broader with under-surface covered with sori. Surfaces naked. Texture thin, herbaceous. The main veins proceeding from the midrib distinct almost to the margin, sometimes indistinct; meshes with free included veinlets.

Distribution: Bombay Presidency—North Kanara—Gersoppa Falls, Mysore side, Sirsi to Siddhapur, Sumkund, Amboli.

Sikkim; Bhotan; Assam; Khasya; Cachar; South India, Tinnevelly mountains, Jeypore Hills.

Var. *lanceolata* Bedd.—It has the main veins indistinct.

Distribution: Bombay Presidency—Mahableshwar on trees; throughout the western forests of the Presidency.

All over the western forests of the Madras Presidency; Ceylon; Chota Nagpur; Parasnath; Burma.

Var. *axillaris* Bedd.

It has a long tortuous rhizome; main veins less prominent than in the type, more so than in Var. *lanceolata*.

Distribution: Bombay Presidency—North Kanara.

In all the western forests of South India; plains of Bengal and Assam; Burma.

2. *Gymnopteris quercifolia* Bernh.

Rhizome stout, creeping, scaly. Stipes of the fertile fronds longer than those of the

sterile. Sterile fronds 3–4 inches long, 1½–2 inches broad, nearly prostrate, more or less oak-leaf-shaped, consisting of a terminal pinna with blunt rounded lobes and a pair of lateral pinnæ which are ovate-blunt, unequal-sided, the inferior portion being longer than the superior. Surfaces hairy. Texture herbaceous. Venation reticulated with free included veinlets in the meshes; main veins distinct to the edge, sometimes scarcely distinguishable from the others. Fertile fronds much contracted, also consisting of a terminal pinna 1–2 inches long, ⅛-inch broad, and smaller lateral pinnæ.

Cultivated.

Distribution: Peninsular India, Tinnevelly and Travancore Hills up to 2,000 feet, Anamallays; Ceylon, about Colombo.—South China; Cochin China.

3. *Gymnopteris flagellifera*

Rhizome creeping, scaly. Stipes often scaly. Fronds simple, 3-foliate or pinnate with 5–11 pinnæ, the terminal pinna often much prolonged and proliferous at the apex. Pinnæ entire or with shallow lobes or distinctly lobed, 4–5 inches long, 2 inches broad. Texture herbaceous. Venation reticulate with or without free

included veinlets in the meshes. Fertile pinnæ more or less contracted, wholly soriferous or partially covered with elongate confluent sori.

Cultivated.

Distribution: North India, Sikkim and Assam, Cachar and Chittagong up to 3,000 feet; Burma.

4. *Gymnopteris contaminans* Bedd.

Rhizome creeping, scaly. Stipe scaly. Fronds up to about 1½ feet long, of two kinds, pinnate; pinnæ of the barren fronds almost sessile, lanceolate, margin entire, slightly crenated or more deeply lobed and serrate segments; terminal pinna more or less elongated, as a rule proliferous; fertile pinnæ much contracted. Surfaces naked. Rachis scaly. Texture membranaceous. Main veins conspicuous two-thirds of the way to the margin; meshes broad, those abutting of the costa without any included veinlets, the others including several veinlets which are either free with clavate apices or join with the mesh above.

Distribution: Bombay Presidency—North Kanara—common in ever-green forests, Gud-

dhali near Karwar, Castle Rock, in shady woods; Vetora (Savantwadi); Matheran.

South India, in the western coast forests from the plains up to 4,000 feet; Ceylon; East Bengal, the lower hills up to 4,000 feet; Burma.

5. *Gymnopteris subcrenata* Bedd.

Rhizome creeping, scaly. Stipe scaly. Fronds 1–4 feet long, of two kinds, pinnate; pinnæ of sterile fronds stalked, lanceolate, acuminate, margin sinuate or wavy, serrated towards the apex, terminal pinna the longest and proliferous; fertile pinnæ much contracted. Surfaces glabrous. Texture almost leathery. Main veins close and conspicuous almost to the margin, the veinlets anastomosing at right angles from which proceed one or two generally free veinlets with clavate apices.

Distribution: Bombay Presidency—North Kanara—common in ever-green forests, Castle Rock, in shady woods and on banks of streams, Gersoppa Road; Mahableshwar; Matheran; Khandala, ravine behind Coona in thick forest; Kodawli (Rajapur); Amba (Manoli forest); Thana District, Sasamghar forest (Bassein).

Not uncommon in the western forests of the Presidency.

In the western moist forests of the Madras Presidency up to 4,000 feet; Ceylon, Central Provinces.

6. *Gymnopteris presliana* Bedd.

Rhizome creeping, scaly. Stipe 6–10 inches long, scaly. Fronds 6–12 inches long, of two kinds, pinnate; pinnæ of the sterile fronds 2–4 inches long, ½-inch wide, stalked, narrow, lanceolate, gradually tapering at both ends, entire. Fertile fronds much contracted. Surfaces naked, rachis scaly, more or less winged. Texture almost leathery. Main veins indistinct, connected by generally two pairs of opposite veinlets which meet at an acute angle from which proceeds a veinlet which is either free or joined to the veinlets above; marginal veins free, terminating in a dot within the margin.

Distribution: Bombay Presidency—North Kanara—common everywhere in river-beds, Sumkund, Castle Rock, on rocks, in water-course; Konkan.

South India, Coorg—Philippines.

GENUS XLVII.—ACROSTICHUM L.

(Deriv. Gr. *Akros*, highest; *stichos*, order—fructification at the top of the frond.)

Veins uniform, reticulate, meshes without free included veinlets, no main veins present; fronds pinnate, the upper pinnæ smaller and wholly covered with sporangia on the under-surface. Stipes adherent to caudex.

Acrostichum aureum L.

Caudex erect. Stipes tufted, naked, glossy, 1–2 feet long. Fronds 2–6 feet long, 1–2 feet broad, pinnate, the pinnæ lanceolate oblong; apex acute or blunt, sometimes retuse and mucronate; base wedge-shaped; margin entire; the upper pinnæ which, as a rule, are fertile are sessile with the inferior base adnate and decurrent on the rachis; the lower pinnæ sterile and stalked. Rachis and surfaces naked. Texture leathery.

Distribution: Bombay Presidency—North Kanara, on the banks of salt-water creeks and in marshy places near the coast.

Tidal backwaters throughout the Indian region. Throughout the world in warm places near the sea.

SUB-ORDER III.—OSMUNDACEÆ

Capsule two-valved, opening across the apex with a short horizontal ring; vernation circinate.

Genus XLVIII.—Osmunda L.

(Deriv. *Osmunder*, one of the names of Thor, a Celtic divinity.)

Fertile frond wholly on the upper or middle portion contracted, forming simple or compound panicles bearing sporangia; veins forked free; fronds pinnate or bipinnate, articulated with the rachis.

Osmunda regalis L.

Caudex stout, erect. Stipes tufted, 12–18 inches long. Fronds 2–4 feet long, 1 foot or more broad, bipinnate to tripinnate; barren and fertile fronds separate or only the upper part of the frond fertile; sterile pinnules oblong, blunt, with the margins finely serrate or crenate, base unequal; ultimate fertile pinnules cylindrical and covered with capsules; occasionally only a portion of the pinnule fertile and contracted, the other portion remaining sterile. Veins forked free. This is known as the 'Royal Fern'. [Plate XIV.]

PLATE XIV

Angiopteris evecta Hoffm., a pinnule

barren portion. *Lygodium japonicum* Sw. fertile portion.



Lygodium microphyllum R.Br., fertile portion. *Osmunda regalis* L. *Lygodium microphyllum* R.Br., barren portion.

Distribution: Bombay Presidency: North Kanara, in the bed of the river at Jog and other places, Sumkund, Anmod, Castle Rock, on the banks of a tank; Mahableshwar.

South India, on the western mountains at the higher elevations, North India, Kumaon, Bhotan, Khasya, 4,000–6,000 feet.—Asia; North and South Africa; Central and North America; Europe.

SUB-ORDER IV.—SCHIZÆACEÆ

Sporangia two-valved, crowned by a complete apical ring. Vernation circinate.

GENUS XLIX.—ANEMIA Sw.

(Deriv. Gr. *Aneimon*, naked—the naked spikes.)

Sporangia small, very abundant, forming a copiously branched panicle quite distinct from the leafy part of the frond; fronds pinnate or bi-tripinnatifid; veins free.

Anemia rotundifolia Schrad.

Stipes 6–9 inches long, hairy; the fertile and barren portions united in the same frond; the barren portion pinnate, 8–12 inches long, 1–2 inches broad below, often prolonged and rooting at the tip; pinnæ 1 inch long, ⅝–¾ inch

broad, very blunt, the lower side obliquely cut at the base, the outer edge finely toothed. Texture almost leathery. Rachis and surfaces hairy. Veins disposed in a fan-shaped manner. The fertile portion consisting of a panicle 1–3 inches long and a slender stalk 3–4 inches long.

Cultivated.

Distribution: South Brazil.

GENUS L.—LYGODIUM Sw.

(Deriv. *Lygodis*, flexible; the climbing habit.)

Sporangia solitary (or in pairs) in the axils of large overlapping clasping involucres, which form spikes either on separate pinnæ or in lax rows along the edge of the leafy ones. Fronds scandent; pinnæ in pairs (conjugate), palmate lobed, pinnatind or pinnate, veins forked free.

(*a*) Barren pinnules ovate, blunt; the margin entire or lobed.

1. *L. microphyllum.*

(*b*) Barren pinnules again pinnate or variously deeply lobed or almost palmate; margin finely serrate.

(*i*) Pinnules 8–12 inches long, 6–12 inches broad.

2. *L. flexuosum.*

(*ii*) Pinnules smaller, 4–8 inches long, about as broad.

3. *L. japonicum.*

1. *Lygodium microphyllum* R. Br.

Fronds scandent, consisting of a long twining rachis from which arise at intervals short spurs bearing a pair of pinnæ each; pinnæ pinnate, pinnules petioled, 3–4 on each side of a zig-zag rachis with a terminal one which is more or less lobed; barren pinnules ovate, blunt, the margin entire or lobed; fertile ones short, triangular, with a rounded apex and a square base and lobed round the margin. Texture almost leathery. Surfaces naked or nearly so. [Plate XIV]

Distribution: Bombay Presidency—North Kanara, Castle Rock, in dense jungle on the banks of a tank; Ghat jungles and South Konkan.

South India, Malabar and West Coast generally, common in plains and also in the Wynaad, up to about 3,000 feet; North India, Bengal plains; Malay Peninsula—Malay Islands.

2. *Lygodium flexuosum* Bedd.

Pinnæ arising in pairs from the ends of short spurs on the twining rachis. Pinnules 8–12

inches long, 6–12 inches broad, again pinnate or variously lobed or almost palmate; margin finely serrate. Surfaces slightly hairy. Texture almost leathery. [Frontispiece and Plate XIV.]

Distribution: Bombay Presidency—North Kanara, common during the rains, Castle Rock; Konkan, southern part: Penn to Campoli; Khandala; Coona ravine; Parsik Hill (near Thana); Matheran; Mahableshwar; Vetora (Savantwadi); Goa Territory, Marmagoa; Salsette Island, Bhandup, Moolgaum, Kannery caves; Bombay Island, Sion Wood.

South India, common on both sides of the Madras Presidency up to about 4,000 feet; North India plains and up to 5,000 feet; on the Himalayas; Ceylon; Malay Peninsula.—Malay Islands; Philippines; North Australia; Tropical Africa.

3. *Lygodium japonicum* Sw.

As in flexuosum, but pinnæ much smaller; pinnules smaller, 4–8 inches long, about as broad and finely cut, the fertile ones often much contracted. [Plate XIV.]

Cultivated.

Distribution: North India, abundant, extending west to Kashmir, up to 5,000 feet; South

India, western mountains, rare. It is probably only a form of flexuosum.

SUB-ORDER V.—MARATTIACEÆ

Sporangia opening by a slit down one side or a pore at the apex without a ring, usually joined together in concrete masses (synangia), vernation circinate.

GENUS LI.—ANGIOPTERIS HOFFMANN.

(Deriv. *Angio*, open; *pteris*, fern—the open sporangia.)

Sporangia opening by a slit down the side, sessile, very close to one another but not concrete, arranged in linear oblong or boat-shaped sori near the edge of the frond; veins simple or forked, free; fronds very large, bipinnate, often only pinnate. Stipes club-shaped at the base, and springing between two fleshy stipules. Pinnæ and pinnules articulate with the rachis.

Angiopteris evecta Hoffmann.

A handsome gigantic fronded fern. Caudex short, about two feet high. Fronds 6–20 feet long, bipinnate, often only pinnate; rachis swollen at the base; pinnules (or in the case of pinnate fronds, pinnæ) 4–12 inches long, ½–1½ inch

broad, linear, oblong, with the apex acuminate; margin entire or toothed. Surfaces naked, shining. Texture herbaceous to almost leathery. Veins almost parallel. [Plate XIV.]

Distribution: Bombay Presidency—North Kanara, Castle Rock, by a stream in evergreen forest, Katgal; Vetora (Savantwadi) by a stream on a hill; Southern Konkan.

Throughout the Indian region up to 7,000 feet.—Japan; Tropical Australia; New Caledonia; Madagascar; Polynesia.

Also cultivated.

SUB-ORDER VI.—OPHIOGLOSSACEÆ

Sporangia deeply two-valved, opening down the side nearly to the base, without a ring; vernation erect. Fronds bearing a sterile and fertile branch on the same stem.

GENUS LII.—OPHIOGLOSSUM L.

(Deriv. *Ophis*, a snake; *glossa*, a tongue.)

Sporangia sessile, arranged in two rows, forming a narrow close spike which arises from the base or centre of the barren segment, rarely distinct, rising direct from the rhizome; veins reticulate; fronds simple, entire, rarely palmate.

(*a*) Rhizome elongated, cylindrical, not tuberous; midrib indistinct.

(*i*) No persistent sheaths on the rhizome.

1. *O. vulgatum.*

(*ii*) Persistent brown sheaths on the rhizome.

2. *O. aitchisoni.*

(*b*) Rhizome somewhat tuberous, midrib indistinct, plants very minute.

3. *O. nudicaule.*

(*c*) Rhizome distinctly tuberous, midrib prominent.

4. *O. fibrosum.*

1. *Ophioglossum vulgatum* L.

Under this name we have lumped together the hitherto separate species *O. vulgatum* L. and *O. reticulatum* L. as they are merely forms of the same species, being connected by a number of transitional stages.

Rhizome cylindrical, elongated; sterile division of frond 1–4 inches long, ½–2 inches broad, ovate, ovate-oblong or lanceolate, blunt or acute at the apex, often distinctly cordate at the base, stalked or sessile veins clear, often

scarcely visible, no midrib; fertile spike 1 inch or more long on a stalk 2–6 inches long.

2. *Ophioglossum aitchisoni* d'Almeida.

Spec. nov.

Rhizome elongated, not tuberous, with several fibrous rootlets and crowned with a tuft of brown persistent sheaths surrounding the bases of the fronds; fronds several on the rhizome, sterile division 1½–2½ inches long, ½–¾ inch broad, linear lanceolate, acute or mucronate. Veins visible in dry specimens, but not quite distinct, no midrib; texture stout; fertile division arising from a little above the base of the sterile lamina, fertile spike 1 inch long on a peduncle 2 inches long. [Fig. 43.]

Distribution: Bombay Presidency—Siroor Horse-breeding Farm near Poona.—N.-W. Himalayas—Cherat 9,000 feet, Mount Tilla.

Africa; Abyssinia.

3. *Ophioglossum nudicaule* L.

Rhizome small, slightly tuberous. Fronds very minute, 1 inch or more long. Sterile and fertile segments on the same stipe; sterile segment ½–1 inch long, 2–5 lines broad, linear to ovate, sessile or slightly stalked.

Texture thin. Venation reticulate but without any evident mid-vein or main veins. Fertile spike ½–1 inch long on a slender foot-stalk 2 inches long.

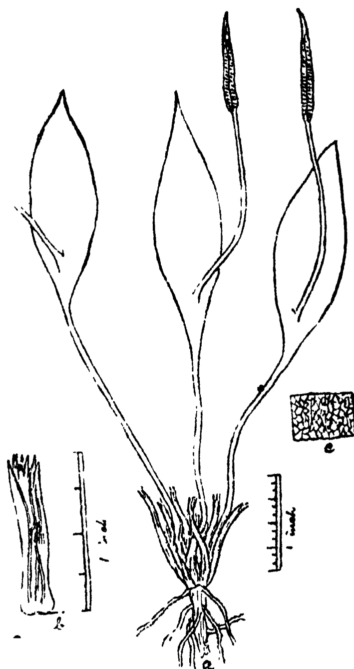


FIG. 43.—(*a*) *Ophioglossum aitchisoni* d'Alm.
(*b*) Sheath. (*c*) Portion of sterile division showing venation

Distribution: Bombay Presidency—North Kanara, Karwar in the rains, Castle Rock; Khandala.

South India, Anamallay forests, and on the western mountains; Malay Peninsula—America from United States southward to Brazil; New Caledonia; Tropical Africa.

4. *Ophioglossum fibrosum* Schum.

Rhizome large, round, tuberous, with numerous fibrous roots. Stipe very short with the sterile segment close to the base, the latter 1½–3 inches long, up to 1 inch broad, lanceolate, acute or obtuse. Texture thick and fleshy. Venation indistinct except when dry, reticulate with free and often forked veinlets in the meshes; midrib prominent, consisting of a single main vein or of 2–3 strong central veins which run parallel and close to each other and fork and disappear near the apex of the barren segment. Fertile spike 1½–2 inches long on a foot-stalk 4–5 inches long. [Plate XV.]

Distribution: Bombay Presidency—Khandala, on rocks and gravelly ground.

South India, Anamallay teak forests 2,000–3,000 feet; Ceylon.—Tropical America; Guinea Coast; Ascension Island.

GENUS LIII.—HELMINTHOSTACHYS KAULF.

(Deriv. *Helminthos*, a worm; *stachys*, a spike.)

PLATE XV



Ophioglossum fibrosum Schum.

Sporangia more or less round, sessile in stalked whorls which are terminated by a crest-like appendage, forming a clustered simple spike, opening vertically by a slit on the exterior side. Fronds divided into fertile and sterile segments, the latter palmately pinnate. Veins forked free.

Helminthostachys zeylanica Hook.

Rhizome fleshy, creeping. Stipe 1 foot long. Frond divided into two portions; barren portion leafy, palmately pinnate, often in three principal divisions which are stalked and again forked or pinnate; ultimate segments linear, oblong, 3–4 inches long, ¾–1 inch broad. Texture herbaceous or leathery. Fertile spike 3–4 inches long, ½ inch broad on a stalk about as long as the spike.

Distribution: Bombay Presidency—Southern Konkan in swampy places.

South India, western forests up to 3,000 feet; Ceylon; North India; Bengal plains to Assam and Cachar; Malay Peninsula—Malay Islands; Philippines; Tropical Australia; New Caledonia.

GENUS LIV.—BOTRYCHIUM Sw.

(Deriv. *Botrys*, a bunch; in allusion to the fructification which is like a bunch of grapes.)

Sporangia sessile, arranged in two rows on the face of the spikes. Fronds consisting of a fertile and sterile segment on the same stipe. Sterile segment leafy, triangular, 2–3 pinnatifidly decompound. Veins forked, free; fertile segment consisting of a stalked spike which forms a compound panicle.

Botrychium virginianum Sw.

Stipes 3–18 inches long; sterile portion not stalked and not prolonged beyond the fertile segment, up to about a foot each way, triangular, four-pinnatifid. Ultimate pinnules cut down almost to the rachis into linear-oblong segments, fertile branch springing from the base of the sterile portion (type) or from the middle of it.

Var. *lanuginosum*.—Surfaces hairy. The fertile branch always springs from the middle of the sterile segment which is more or less hairy.

Distribution: Bombay Presidency—Ghats.

South India, at the higher elevations on the western mountains; Ceylon; North India, on the Himalayas, Kumaon to Bhotan, 5,000–8,000 feet; Khasya, 4,000–6,000 feet.—The type in Europe, America and Japan.

Synopsis of Genera

PAGE

SUB-ORDER I.—GLEICHENIACEÆ

Sori dorsal, without indusium, composed of a few sporangia having a transverse or obliquely transverse complete ring and opening vertically.

Caudex creeping; stipes forked; segments small, almost round or pectinate.

Genus I.—Gleichenia R. Br. 27

SUB-ORDER II.—POLYPODIACEÆ

Sori dorsal or marginal with or without an indusium; sporangia stalked, provided with a vertical more or less complete ring and opening transversely (except in Hymenophylleæ).

(A) *Involucratæ*

Sori furnished with an indusium (except in Alsophila).

PAGE

Tribe I.—Cyatheæ

Tree-ferns.—Sori dorsal, round; sporangia stalked or sessile on an elevated receptacle; indusium inferior, in the form of a scale beneath the sorus, or completely enveloping the sorus, ultimately bursting at the top and forming a cup. It is absent in Alsophila.

Caudex arborescent; indusium globose, ultimately rupturing at the apex so as to form a cup holding the sorus.

Genus II.—Cyathea 29

Caudex arborescent; sori round, naked. (Distinguished from Cyathea by the absence of indusium).

Genus III.—Alsophila R. Br. 31

Tribe II.—Dicksonieæ

Sori round, at the back or apex of a vein; indusium inferior, leathery, mounted on a stalk, covering the whole sorus and bursting irregularly, or cup-shaped, entire or two-lipped. Veins free or anastomosing.

Sori round, arising from the back of a vein or veinlet; indusium inferior, globose,

PAGE

at first enclosing the sorus, ultimately splitting vertically into two lips. Veins free forked, terminating within the margin into clavate (club-shaped) apices.

Genus IV.—Peranema Don. 34

TRIBE III.—HYMENOPHYLLEÆ

Sporangia globose or ovate, furnished with a transverse ring; indusium inferior, two-valved or tubular. Filmy ferns, usually epiphytic in habit.

Sori marginal; indusium more or less two-valved; receptacle elongated, columnar, protruding beyond the mouth of the indusium or included within it.

Genus V.—Hymenophyllum L. 35

Sori always terminating a vein, more or less sunk in the frond; indusium tubular or slightly two-lipped; receptacle elongated, columnar, often considerably protruding beyond the mouth of the indusium.

Genus VI.—Trichomanes Smith 37

TRIBE IV.—DAVALLIEÆ

Sori rounded or oblong, situated at or near the margin; indusium adherent at

PAGE

the base, open at the apex, i.e. exteriorly, open or free at the sides.

Indusium small, narrow, thin, fixed only by its broad base. Rhizome creeping, stipe articulated with the rhizome.

Genus VII.—Leucostegia Presl. 41

Indusium leathery, attached at sides and base, half cup-shaped. Rhizome creeping, stipe articulated with the rhizome.

Genus VIII.—Davallia Sm. 44

Indusium membranaceous, half cup-shaped, attached at the sides and base. Rhizome creeping; stipe continuous with the rhizome. **Genus IX.—Microlepia Presl.** 46

Indusium forming a compressed, almost round or cup-shaped pouch, only open at the top. Rhizome creeping; stipes tufted, not articulated upon the rhizome.

Genus X.—Stenoloma Fee 49

TRIBE V.—LINDSAYEÆ

Sori placed in a line at or near the margin of the frond at the apex of and uniting two or more veinlets. Indusium double, i.e. formed of two valves, the inner of which is membranaceous, the outer

PAGE

formed of the slightly changed margin of the frond.

Veins forked, free; pinnæ unequal-sided or equal-sided. **Genus XI.—Lindsaya Dryand.** 51

Veins more or less uniting. Pinnæ unequal-sided or equal-sided.
Genus XII.—Schizoloma Gaud. 52

TRIBE VI.—PTERIDEÆ

Sori marginal, oblong or in a line. Indusium formed of a more or less changed and reflexed margin of the frond opening inwardly.

Sori marginal, rounded or in a line, usually numerous and distinct, sometimes confluent and continuous, bearing the sporangia on the underside; veins free.
Genus XIII.—Adiantum L. 56

Indusium roundish and distinct, or more or less confluent, but not continuous, sporangia on the underside of the frond, veins free. **Genus XIV.—Cheilanthes Sw.** 75

Indusium quite continuous, sori linear, continuous, occupying a slender filiform receptacle in the axis of the indusium. Veins free, rarely those of the last division

PAGE

but one or more or less connected by arching veins at the very base.

Genus XV.—Pteris L. 80

Fronds triangular or halberd-shaped or palmately divided; veins copiously anastomosing, without free included veinlets. The rest as in Pteris.

Genus XVI.—Doryopteris J. Smith 94

Veins copiously anastomosing with free included veinlets. The rest as in Pteris.

Genus XVII.—Lithobrochia Presl. 95

Fertile fronds with the segments forked and pod-shaped. Sori linear, marginal, almost parallel. Veins of sterile frond transversely elongated and distantly anastomosing. **Genus XVIII.—Ceratopteris Brong.** 96

TRIBE VII.—BLECHNEÆ

Sori linear, oblong, parallel with the midrib and margin, nearer the midrib; indusium linear, opening towards the midrib.

Sori linear, mostly continuous, parallel to and quite close to the midrib; veins free. **Genus XIX.—Blechnum L.** 97

TRIBE VIII.—ASPLENIEÆ PAGE

Indusium linear or oblong or horse-shoe-shaped, sometimes double; sori attached to the veins.

Sori linear; veins forked, more or less parallel, connected just within the margin by a transverse vein. (This connection is not quite constant.) Fronds simple.

Genus XX.—Thamnopteris Presl. 101

Sori linear or oblong, single, veins free.

Genus XXI.—Asplenium L. 103

Veins free, sori more or less curved, sometimes horseshoe-shaped.

Genus XXII.—Athyrium Roth 110

Veins free, some of the sori double, that is, on each side of the vein, others single as in Asplenium.

Genus XXIII.—Diplazium Swartz 116

Veins anastomosing; sori as in Diplazium. **Genus XXIV.—Anisogonium Presl.** 120

Veins anastomosing; areoles elongated near the midrib, smaller towards the margin, with free marginal clavate veinlets. Sori linear-oblong. Indusium sausage-shaped, quite covering the sorus and bursting irregularly down the centre.

Genus XXV.—Allantodia Wall 121

PAGE

Fronds fan-like, sori placed on each side of the narrow segment of the frond, linear, elongated, opening towards the midrib.

Genus XXVI.—Actiniopteris Link 122

TRIBE IX.—ASPIDIEÆ

Indusium more or less rounded or kidney-shaped (rarely elliptical), attached either by the centre or sinus.

Sori elliptical on the tip of a veinlet but within the margin. Indusium attached longitudinally on the centre of the linear receptacle, free all round the edge. Veins pinnate, the lower pair of veinlets anastomosing. Fronds bipinnatifid.

Genus XXVII.—Mesochlæna R. Br. 123

Sori globose; veins free; texture leathery, teeth awned.

Genus XXVIII.—Polystichum Roth. 124

Indusium round, attached by the centre; veins generally anastomosing with free veinlets proceeding from their junction. **Genus XXIX.—Cyrtomium Presl.** 127

Veins copiously anastomosing with free included veinlets in the areoles. Sori ound. Indusium round or kidney-shaped.

PAGE

Receptacle at the junction of the veinlets or at the apex of free veinlets.

Genus XXX.—Aspidium Schott 128

As the Aspidium but only the lowest veinlets of the vein anastomosing so as to form a series of areoles near the costa without any free veinlets within them. All the other veinlets as a rule free. Sori generally at the apex of the free veinlets, sometimes on the netted veins.

Genus XXXI.—Pleocnemia Presl. 134

Sori somewhat round on the back or on the apex of veinlets.

Indusium kidney-shaped attached by the sinus. Veins all free. Fronds pinnate or compoundly 2-4 pinnate.

Genus XXXII.—Lastrea Presl. 137

Sori round; indusium kidney-shaped (often like that of Athyrium or Asplenium in *N. subpectinatum*), sometimes absent. Veins pinnate, one or more of the lower veinlets anastomosing at an angle with corresponding ones of the next group, producing from their junction an excurrent veinlet which is either free or joined in the angle of the next superior

PAGE

pair. Fronds pinnate, pinnæ as a rule pinnatifid. **Genus XXXIII —Nephrodium Schott.** 147

Sori round, indusium kidney-shaped or roundish; veins forked, free, with club-shaped apices. Fronds simply pinnate, pinnæ articulated and furnished with white dots above.

Genus XXXIV.—Nephrolepis Schott 156

Sori round, in a single row on each side of the midrib. Indusium kidney-shaped. Fronds entire. Stipes pointed. Rhizome wide-creeping. **Genus XXXV.—Oleandra Cav.** 162

(B) *Exinvolucratæ.*

Sori without an indusium.

TRIBE X.—POLYPODIEÆ

Sori on the back of the lobes, round or rarely somewhat oblong.

Desmobryoid Series.—Habit and mode of growth of Aspidieæ, the stipes continuous with the caudex; sori generally medial on the veins.

Veins forked or pinnate, veinlets free. Habit of Lastrea, but indusium wanting.

Genus XXXVI.—Phegopteris Fee 163

PAGE

Habit and venation of Nephrodium, i.e. fronds pinnate, veins pinnate, one or more of the lower veinlets anastomosing at an angle with corresponding ones of the next group producing from their junction an ex-current veinlet. Indusium wanting.

Genus XXXVII.—Goniopteris Presl. 164

Eremobryoid Series.—Stipes articulated with the rhizome. Sori generally, not always, terminal on the veins.

Sori round or oval, superficial or buried in the hairs. Fronds as a rule simple, covered beneath with a dense coating of stellate hairs. Veins copiously anastomosing, obscure, undefined or evident with the main veins prominent. Fertile fronds more or less contracted and longer than the sterile.

Genus XXXVIII.—Niphobolus Kaulf. 165

Rhizome short, thick and fleshy. Fronds rigid, the sterile when present like an oak-leaf; fertile frond pinnatifid or pinnate, rarely simple. Veins copiously anastomosing forming square or hexagonal areoles. Sori small, round or oval, numerous.

Genus XXXIX.—Drynaria Bory 167

PAGE

Fronds simple, pinnatifid or pinnate. Veins copiously anastomosing with free included veinlets.

Genus XL.—Pleopeltis H. and B. 168

TRIBE XI.—GRAMMITIDEÆ

Sori on the back of the lobes, more than twice as long as broad, usually linear.

Sori arising from the veins over the under-surface of the frond, linear and usually forked. Habit and mode of growth of *Cheilanthes*.

Genus XLI.—Gymnogramme Desv. 175

Veins simple, forming an acute angle with the midrib and having their apices prolonged into a transverse marginal vein which eventually becomes the receptacle. Sori situated in a longitudinal slit of the margin. Fronds simple, linear, grass-like.

Genus XLII.—Vittaria Sm. 177

Veins reticulated and wholly covered by sporangia, the sori being in fact reticulated. Fronds either simple, pinnatifid or pinnate. **Genus XLIII.—Hemionites L.** 178

PAGE

Tribe XII.—Acrosticheæ

Sori spreading over the whole under-surface or rarely over both surfaces of the frond, not confined to the veins only. Fertile fronds or segments always more or less contracted.

Fronds of two forms: the fertile fronds contracted and very narrow; the barren fronds simply pinnate; the pinnæ leathery in texture; veins simple or forked, fine and close, generally quite free to the margin, rarely anastomosing; stipes adherent to the rhizome; pinnæ articulate with the rachis.

Genus XLIV.—Stenochlæna J. Sm. 181

Fronds pinnate, bipinnatifid or almost pinnate, bipinnate; sterile frond generally proliferous; fertile frond much contracted; veins pinnate, all free; stipes adherent to rhizome. **Genus XLV.—Polybotrya H. B. K.** 182

Veins copiously anastomosing with free veinlets in the meshes; main veins distinct or not distinguished from the rest; fronds simple or pinnate, generally of two forms, the fertile being much contracted, or rarely simple and all similar, bearing the

PAGE

sori on the contracted apex ; stipes adherent to the rhizome.

Genus XLVI.—Gymnopteris Bernh. 183

Veins uniform, reticulate, meshes without free included veinlets, no main veins present ; fronds pinnate, the upper pinnæ smaller and wholly covered with sporangia on the under-surface. Stipes adherent to caudex. **Genus XLVII.—Acrostichum L.** 191

SUB-ORDER III.—OSMUNDACEÆ

Capsule two valved, opening across the apex with a short, horizontal ring ; vernation circinate.

Fertile frond wholly on the upper or middle portion contracted, forming simple or compound panicles bearing sporangia ; veins forked free ; fronds pinnate or bipinnate, articulated with the rachis.

Genus XLVIII.—Osmunda L. 192

SUB-ORDER IV.—SCHIZÆACEÆ

Sporangia two-valved, crowned by a complete apical ring. Vernation circinate.

PAGE

Sporangia small, very abundant, forming a copiously branched panicle quite distinct from the leafy part of the frond; fronds pinnate or bi-tripinnatifid; veins free. **Genus XLIX.—Anemia Sw.** 193

Sporangia solitary, (or in pairs) in the axils of large overlapping clasping involucres, which form spikes either on separate pinnæ or in lax rows along the edge of the leafy ones. Fronds scandent; pinnæ in pairs (conjugate), palmate lobed, pinnatifid or pinnate, veins forked free. **Genus L.—Lygodium Sw.** 194

SUB-ORDER V.—MARATTIACEÆ

Sporangia opening by a slit down one side or a pore at the apex without a ring, usually joined together in concrete masses (synangia), vernation circinate.

Sporangia opening by a slit down the side, sessile, very close to one another but not concrete, arranged in linear oblong or boat-shaped sori near the edge of the frond; veins simple or forked, free; fronds very large, bipinnate, often only pinnate.

PAGE

Stipes club-shaped at the base, and springing between two fleshy stipules. Pinnæ and pinnules articulate with the rachis.

Genus LI.—Angiopteris Hoffmann 197

SUB-ORDER VI.—OPHIOGLOSSACEÆ

Sporangia deeply two-valved, opening down the side nearly to the base, without a ring; vernation erect. Fronds bearing a sterile and fertile branch on the same stem.

Sporangia sessile, arranged in two rows, forming a narrow close spike which arises from the base or centre of the barren segment, rarely distinct, rising direct from the rhizome; veins reticulate; fronds simple, entire, rarely palmate.

Genus LII.—Ophioglossum L. 198

Sporangia more or less round, sessile in stalked whorls which are terminated by a crest-like appendage, formi g a clustered simple spike, opening vertically by a slit on the exterior side. Fronds divided into fertile and sterile segments, the latter

PAGE

palmately pinnate. Veins forked free. **Genus LIII.—Helminthostachys Kaulf.** 202

Sporangia sessile, arranged in two rows on the face of the spikes. Fronds consisting of a fertile and sterile segment on the same stipe. Sterile segment leafy, triangular, 2–3 pinnatifidly decompound. Veins forked, free; fertile segment consisting of a stalked spike which forms a compound panicle. **Genus LIV.—Botrychium Sw.** 203

INDEX

PRINTED AT THE DIOCESAN PRESS, MADRAS, 1922.